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JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania;

DEVOTED TO THE

MECHANIC ARTS, MANUFACTURES, GENERAL SCIENCE,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED
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JULY, 1832.

FRANKLIN INSTITUTE.

Explosions of Steam Boilers.

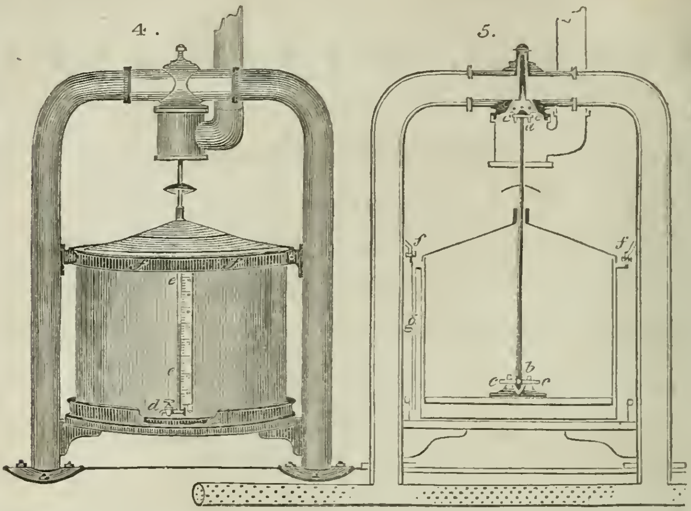
Communication to the Committee of the Franklin Institute, on the Explosions of Steam Boilers, from Thomas Ewbank, *of New York city.*

(Continued from p. 369, vol. ix.)

An improvement in the safety valve, particularly in obtaining and limiting the pressure upon it, is still considered a desideratum. The result of my efforts on this part of the steam engine is the hydrostatic valve published in the last number of the Journal, (vol. ix. pp. 64 and 65,) and to which I beg leave to refer. It combines *both* the valve and gauge with its tell-tale. As a gauge *alone*, for high pressure engines, I think it deserving of attention.

The committee can determine whether the defects of the ordinary safety valve are obviated or not in this device. A simple addition, made to it since the first description was written, may here be mentioned, as it is a still further security against adhesion. A slit *a*, (see fig. 5,) is made in that part of the valve which receives one end of the rod, and a similar one, *b*, on the plate that receives the other end in the bottom of the inner vessel: a short pin, *c c*, is passed through the rod at half an inch from each of its ends, which slip loosely into the slits, (the rod pressing only on its central points,) so that when the inner vessel is moved round, the valve is moved round also with it, even when the steam is pressing against it.

It is often desirable to know the strength of the steam when not blowing off; to ascertain this, the cock *d* (in fig. 4) is opened, and the water allowed to subside until the steam begins to open the valve, when the mark on the glass tube *e e*, opposite the surface of the fluid, indicates the pressure. The figures just referred to, are given because they represent this valve more in detail than the plate formerly given.



In the plan of the valve, as first described, the liquid was suffered to run over the edge of the outer vessel. Now a rim, *f*, is added, from which a pipe, *g*, (fig. 5) conveys the surplus fluid into the receiver below. This pipe passes down behind the graduated plate shown in fig. 4. The cocks figured in the former plate are dispensed with. The tension of steam indicated by the plate, (see fig. 4) is 50; the surface of the fluid being at that height in the glass tube, and consequently the same in the outer vessel. The rim of the outer vessel is bolted to the steam pipes, to prevent the apparatus from being raised, thus preventing the valve from opening. It has been suggested that the evaporation of the fluid in the outer vessel, would require a constant supply. This supply is abundantly furnished by portions of condensed steam frequently oozing through the valve. (See remarks on the valve, p. 69 of the last volume.)

Should mercury, instead of water, be used, the hydrostatic apparatus should be made of cast iron, and turned smooth; the rim on the outer vessel being made capacious enough to receive the surplus fluid expelled by the opening of the valve. The size of the whole would scarcely exceed one-twelfth of that for water. No cocks in the outer vessel would be required. I have a plan and drawings of one, (including the gauge,) for mercury, but as it has not yet been put in practice, I need not describe it.

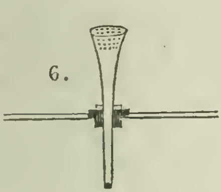
3d. Deficiency of water.—This is directly and indirectly, perhaps, the most frequent source of the injury and of the explosion of boilers. Many boilers have been caused to leak, and others have been rendered useless by being overheated and burned, while little or no water was in them, although no explosion was produced.

A boiler, (the one alluded to in the former part of this communication,) which I erected about three years since, was, when nearly new, in danger of being destroyed from this cause. The water had been permitted to subside below the flues, and the first intimation of the fact was given by the steam rushing violently out of the steam pipe, at a joint five feet from the boiler, the solder of which it had melted. The covering round the pipe and the packing of the piston were also burned by it. In this instance, the boiler was probably saved by the fusion of the joint. It was made of common plumber's solder, the melting point of which is about 400°.

This circumstance naturally leads the mind to fusible plugs and plates, as the principle on which they act, was fully exemplified in the melted joint. It would appear that some similar mode of applying them would be more advantageous than the ordinary way of placing them in the bottom of boilers.

A very small iron or copper tube, of a tapering form, inserted into a boiler, and having one end closed by a fusible plug, (or a few inches of the closed end formed of the fusible metal,) would answer every purpose of a "tell-tale." The small escape of steam would be no very serious occurrence to passengers, or to the progress of the boat; yet it would be sufficiently so to the engineer to secure his attention. The fusible tube should be *thinnest* where it unites with the other, as in that case it would melt there first, and would then drop into the boiler, leaving the pipe clear. (See fig. 6.) The upper end ought to be closed and perforated with holes to prevent it from being plugged up.

6.



A deficiency of water is supposed by many to have been the primary cause of the dreadful explosion (Sept. 24, 1830,) of a high pressure cylindrical boiler, belonging to Mr. M'Queen of this city: this explosion entirely demolished the large brick building in which the boiler was placed, and killed the engineer, and one other person. The boiler was twenty feet long, thirty inches in diameter, and made of one-fourth inch American iron; it had no interior flues, and was in very little worse condition than when new. It was placed a little below the level of the street, in the lowest floor of the building, its front end facing the street. The fracture took place near the bridge wall, or further end of the furnace, (its hottest part,) and divided the boiler into two pieces. The front end of the boiler, about five feet long, was projected through the front wall of the building, across the street, through the front of a frame house opposite, and lodged in the middle of the second floor. The other piece was found resting on a part of the bed of brickwork in nearly a perpendicular position, with the fractured end upwards.

The line of the fracture was very irregular, not confining itself to the seams, but passing through the middle of one or two of the sheets. The engine was going at an increased speed, so as to attract the attention of Mr. J. M'Laren, the foreman of the foundry, who directed the attendant to slacken it, as the blast of air to the cupola furnace, (the apparatus for producing which the engine was driving,) was too great at the time. In about five minutes after this, the explosion took place. It is supposed that the attendant had discovered, immediately before the explosion, that there was a deficiency of water in the boiler, and had just opened the communication with the forcing pump, as he was found lying by the feed cock which was open. He might, however, have had the direction of Mr. M'Laren in view in performing that operation, *if the cock were not actually opened before the directions were given.* The appearance of the fractured part gave no indication of the boiler having been burnt, or otherwise injured by the fire. The load on the safety valve, or the tension of steam necessary to raise it, was wholly unknown, and yet additional weights were occasionally added. The attendant had been recently employed on the premises as a labourer, but from his representing himself as having previously had charge of an engine, was permitted to attend it. He is generally believed to have been very incompetent for so important a charge. An unusual difficulty occasionally attended the feeding of this boiler. When the steam was very high, and the water low, the pump could not force the water through the feeding pipe, until it (the pipe,) was cooled by the application of cold water "*to condense the steam in it*:" after the pipe was once filled with water, the supply was continued without difficulty. It would seem from this, that the water must have been very low, or that the feeding pipe did not descend low enough into the boiler; it might, however, have been influenced by the resistance of the heat, which subject, the following observations may still further illustrate.

When several boilers, on the same level, are used together, and fed by a pipe attached to only one of them, (the rest being connected by tubes to the first,) water will not stand on the same level in each; on the contrary, those boilers which are most highly heated, will *always* have the *least* water in them. This fact has been repeatedly, and I think conclusively, established. It has been a common occurrence in the use of those thin rectangular boilers so often used for small stationary engines. Fig. 7, represents a vertical section of a set of these boilers belonging to Mr. Fanshaw of this city, and will serve for illustration. A, B, C, D, show the front end of the boilers; F, the feeding pipe, which terminates in D; C, B, A, are supplied with water from D through the tubes *o o o;* S, is the steam pipe.

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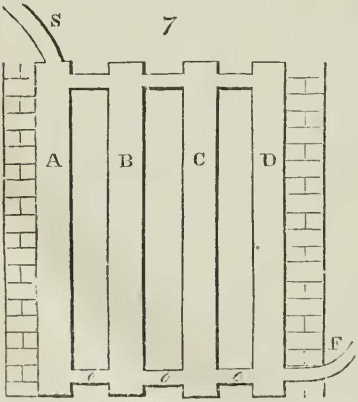
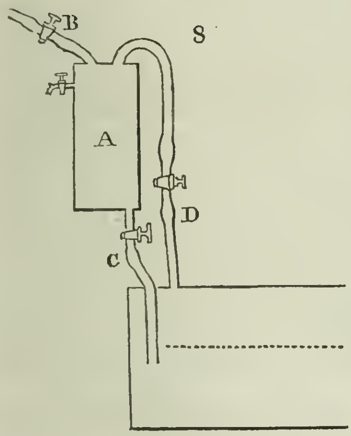


The external sides of A and D are inclosed in brickwork. The fire circulates under and between the boilers, embracing both sides of B and C, but only one side of A and D. Consequently, the temperature of B and C is kept at a higher range than that of A and D. Now there was always great difficulty in keeping the water *in* the middle boilers, *though none whatever in the others.* It would frequently stand twelve inches higher in them than in B and C, and yet *it had to pass through them to feed* A, (which was always fully supplied;) B and C were also *frequently burnt out*, while the others remained perfect. This is, in my judgment, a very clear exemplification of the great repellent power of heat; the deficiency not being caused, (as was supposed,) from the greater elasticity of the steam in the middle boilers, for the pipes uniting them at their upper parts, would equalize the tension of the steam in all. It presents also a strong admonition to have each boiler (where several are used,) supplied with water independently of the rest.

Mr. Fanshaw adopted this plan, for which a patent was obtained,* and by it has completely avoided the difficulty and danger above mentioned.

In attempting to devise other modes of supplying water to boilers, the most promising in appearance was the following:



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A, fig. 8, represents a closed vessel placed above the boiler, so as to be surrounded by the flues of the furnace, after they leave the boiler. This vessel is supplied with water by the pipe and cock B, from a reservoir: the small cock at top is to allow the air and steam to escape for that purpose. The water descends from A into the boiler by the pipe and cock C. The pipe and cock D are to admit the steam on the surface of the water in A to neutralize the pressure of the steam on the mouth of C, after the two upper cocks have been closed.

This apparatus did not answer the very sanguine expectations formed of it. Mr. R. M'Queen, jr. also attached it, in 1828, to one of the boilers in their establishment. It was, however, laid aside as inferior to the pump.

In endeavouring to prevent danger arising from want of water, I have sought for a method of making it known, in preference to any apparatus for supply; because I believe it to be of far more importance to *know when* a deficiency occurs, and how long it remains, than to depend upon any method of supply however excellent in itself. The best of pumps, and other apparatus for the same purpose, may, and do, get out of order, and the difficulty is not to repair *them*, but to ascertain *when* they cease to act. When such is the case, and an engine is in full operation, a very few minutes are of immense importance in obtaining a knowledge of the fact, because the approach and increase of danger, then keep pace with the consumption of the steam.

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* See Journal Franklin Institute, vol. iv. p. 179.

One of the chief obstacles to overcome in attempting to ascertain the true line of the water's surface is from the agitation of the water. Glass tubes have been used to expose it to the sight, but there is a difficulty in keeping them sufficiently clean for that purpose, and they are very liable to fracture. Besides, unless the water be at rest, the apparent line in the glass may be very different from the true level of the great bulk of the fluid.

To the same cause may be attributed the inaccuracy to which gauge cocks are occasionally liable: more especially when inserted through the top of a boiler, or when turned down after entering the sides, portions of water being constantly thrown up into their tubes, and expelled by the steam when they are opened.

Should the tube recommended, (fig. 1, p. 366, vol. ix.) answer the purpose of lessening or destroying the ebullition as supposed, gauge cocks will afford more certainty in their operations.

Floats have been much used in stationary engines, and have been recommended for boilers in steam-boats, but there are too many defects in them as ordinarily used, to permit their being safely relied upon. Their form is defective. The solid float requires to be balanced outside of the boiler, which makes it too complex, and renders it more liable to derangement. The hollow metallic floats are in danger of being collapsed. Both kinds are clogged with the stuffing box, which is sufficient to destroy all accuracy in them. And should a valve be used as recommended by Mr. Cassedy, page 98 of volume ix. the pressure of the steam on the area of the valve would prevent it from being opened. The water might subside, and leave the float suspended in the steam, should the tension of the steam, and the area of the valve, be sufficiently great. I fell into this same error, as may be seen p. 236, vol. vi. Journal of Franklin Institute, fig. 2, which could not pass through Dr. Jones' hands without immediate detection.

The great object in a float, is to make known the least decrease of water, in the shortest possible time after it has occurred. To accomplish this, much depends on the form given to it. That its ordinary form is not the best adapted to this purpose, will be evident from what follows. The solid floats of Bolton and Watt, and, so far as I know, of all others, are in the form of a rectangular prism: their upper and under surfaces being equal, and their sides at right angles to them. Let a float of this description, say twelve inches square, and six inches deep, be properly adjusted to a boiler; and suppose the water to subside one inch below its upper surface, it will then have 144 cubic inches of its contents above the fluid, and its weight consequently increased by that of the same quantity of water: that is, it will preponderate, (deducting friction, &c.) with a force equal to the weight of so many cubic inches of water. Now let another float of the same solid contents and *perpendicular depth* as the above, be made in the form of an inverted cone, (the diameter of its base would be 23.5 inches,) then let the water subside one inch below its surface, and the contents of the frustum exposed above the fluid, would be 360 cubic inches; consequently, it would preponderate with a force compared to that of the other as five to two; that is two and a half times as great, or, it would have the *same power* to make known a deficiency *before* the water had subsided *one half* the distance. *And this advantage of the cone will apply to all floats, solid or hollow, and whether their specific gravities be greater or less than that of the fluid in which they rest.*

It does appear that if a float could be made, without being subject to the evils before mentioned, it would prove as perfect an indicator of a deficiency of water, as any other apparatus yet devised. The following is a description of one designed to obviate those evils. It is the result of much mental and manual labour, and has consumed the greatest portion of my time for the last two years. I have had it in use for the last ten months, and its accuracy has far exceeded my anticipations. It has never once failed in making known the height of the water when at a certain point, and I do not believe the water can subside one-fourth of an inch below that point without the fact being made known by it, and *that whatever may be the tension of the steam in the boiler.* We work the steam ordinarily at 70 lbs. on the inch. The hydrostatic valve is placed on the same boiler, and is constructed to blow off at 80 lbs.

The committee will be able to judge how far I am under the influence of that partiality to their own productions common to inventors. They will also perceive how far this device is applicable, (if at all,) to boilers in steam boats. I think it could be usefully introduced in those that navigate smooth waters, (if not in all,) as it is not subject to the agitation, or swinging motion of the common float.

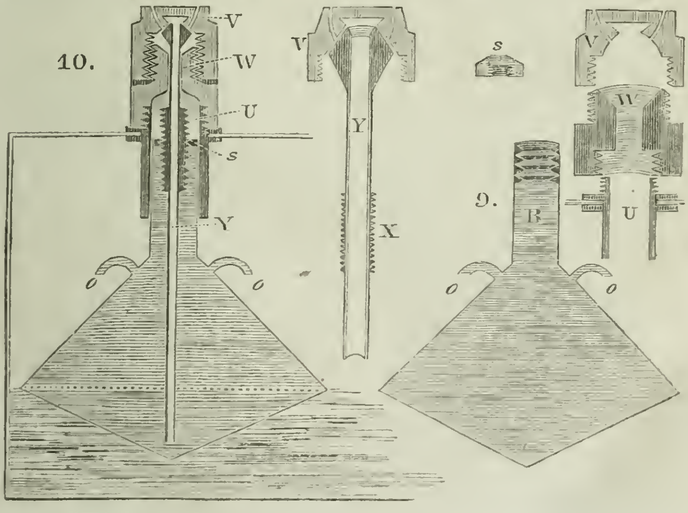


Fig. 9, is a section of the float, being a double cone, that is, two cones united at their bases, made of thin sheet copper. The lower one being the float proper, the upper one terminating in the tube B, which has a female screw formed at its end: *o o* are two short bent tubes, to preserve a communication between the steam in the boiler and the interior of the float; they are preferred to mere holes, as they prevent mud, &c. from falling into the float when thrown up by the agitation of the fluid.

U, is a tube six inches long and two in diameter, securely fixed on the top of the boiler, four inches of its length being inside, and the rest outside of the boiler; a screw is formed on the latter part. The neck of the float or tube B is made to move easily in U, which thus serves as a guide. Y, is a tube rather longer than the depth of the float; a screw four or five inches long is formed on it at X, which fits into the corresponding screw on the neck of the float: a sufficient length is given to X, to adjust by it the float to the required surface of the water in the boiler. S, is a nut to screw on X, close to the top of the float, after it has been united to the latter, to steady them; a collar may be placed between them, to make them steam tight, though this last is not necessary. The lower end of Y reaches to within half an inch of the lowest part of the float. Its upper end is formed into a valve, which is ground air tight to its seat at V; it is made a little spherical to admit of the small motion or play of the neck of the float in U: in the centre of the valve seat, or the part ground, are drilled two small holes, half an inch in diameter, through which the steam escapes, when the valve opens, by the sinking of the water, thus giving notice of the fact.

W, is made to screw on U as represented, it serves as a guide to the part of Y above X: its upper part is formed to receive the under side of the valve, which may be ground to fit it, (the die is not essential,) so that when the valve is opened, *all* the steam which escapes may pass through the float. It is also conveniently separated from U for the purpose of altering or adjusting the depth of the float in the boiler by means of the screw X. The committee will perceive that the pressure of the steam against the valve, is neutralized by its pressing equally (through the tube in the float,) against the valve *seat* at V. The whole of the parts are represented together in fig. 10; the water in the boiler being as high as required, the valve is closed. Suppose the water to subside half an inch, the valve opens and the steam escapes through the float, up the tube Y, and through the small openings at V. I placed over V, a trumpet mouthed organ pipe, the noise of which was so great as to draw the attention of people in the street, (190 feet distance,) who supposed the boiler had burst. I afterwards closed one of the openings as the other was quite sufficient for every purpose of a tell-tale, by the noise of the escaping steam, without the addition of any instrument whatever.

It may be supposed by some persons that water (condensed steam,) would collect in the float and so destroy its buoyancy, but I never found this to be the case, although I have frequently unscrewed W, and taken out the tube Y: indeed, were it to collect there, it would open the valve by its weight, and be expelled by the steam. This, however, never took place but twice, both of which times the feeding pump had been suffered to work until the water had risen nearly to the small tubes *o o*, when of course it entered the float, but gave immediate notice of the excess of water, by being expelled through the openings at V.

The agitation of the water, has little or no effect on this float; this, however, may be owing to the small size of the boiler and engine. The valve is never opened until the water is on the verge of its prescribed limits, when the valve will alternately open and close, perhaps twice, in the space of a minute, thus giving notice of the approach of a decrease of water. In such cases, a few, say six to eight, strokes of the pump will silence it. After the valve is completely opened, fifty strokes of the pump invariably close the valve. The boiler, as before mentioned, is twenty feet long, and two feet in diameter. The diameter of the feeding pump is two and three-eighths inches, and the length of its stroke six and a half inches. These dimensions, taken in connexion with the facts stated above, show the very small decrease in the depth of the water in the boiler which is made known by this float. The committee will perceive that the float cannot sink more than one half an inch whatever may be the decrease of water in the boiler, as its lower part rests, when opened, that distance upon the corresponding part of W. That distance for the valve to open is abundantly sufficient. The valve itself is only five-eighths of an inch in diameter.

I have made many other floats during the last three years, but this embraces the best features of them all; it is therefore unnecessary to describe them at present.

The last cause of explosions mentioned in the commencement of this paper is neglect. Perhaps every thing that could be said on this subject, has been anticipated in those communications already published by the committee, I therefore pass to the consideration of the means proposed for confining the effects of an explosion to the vicinity of the boiler itself.

For this purpose bulk heads have been strongly recommended. Perhaps they could not be made to impart equal security, to take up less room, &c. better than in the form of an extra boiler, or strong cylindrical casing of iron, inclosing the boiler proper, with a certain space between them. When boilers are placed fore and aft, and on the guards, the end of this casing might be left open. This plan would have important advantages which no bulk heads could possess. The space between it and the boiler, would allow for the expansion of the steam in case of explosion, and by its cylindrical form, the effect would, in a manner, be isolated, and so prevented from expending its energy against the boat. I have no doubt, however, that a steam-boat may be made quite secure without either of these devices.

The different subjects proposed to be embraced in this letter, have now been discussed. I shall be much gratified should my communication contain any thing calculated to prevent explosions, or to increase our confidence in the use of the steam engine, that "noblest work of man."

THOMAS EWBANK.

Continuation of the Report of the Committee of the Franklin Institute of Pennsylvania, appointed May, 1829, *to ascertain, by experiment, the value of Water as a Moving Power.*

(Continued from p. 377, vol. ix.)

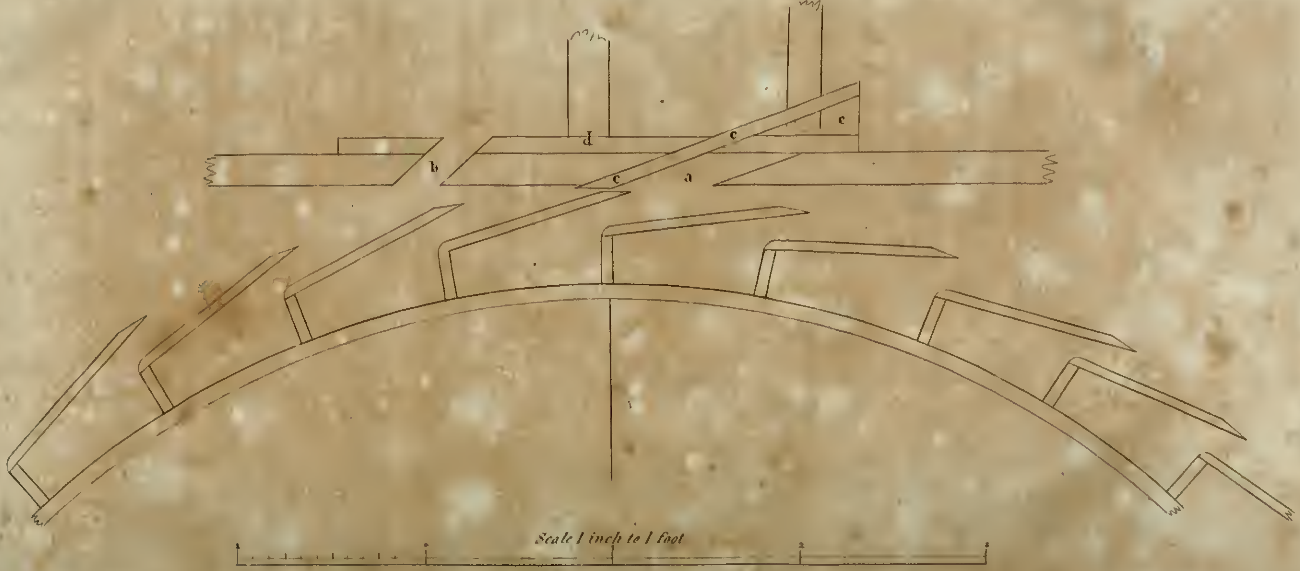
WHEEL NO. III.

The diameter of this wheel was ten feet. The wheel having been substituted for No. II. and the necessary alterations made in the apparatus, the friction of the wheel and drum was examined, and ascertained to be, in each, one per cent. of the weight applied.

The differences of weight which were applicable to the experiments with the larger wheels, would have been too considerable for that under consideration. Variations were made occasionally of fourteen pounds, and usually of twenty-eight, or fifty-six pounds; the leads of 103 lbs. were sometimes used to make up a considerable weight. With small apertures it was found necessary to remove the leads which in the former experiments were contained in the iron basket. The friction table will, therefore, contain instead of the usual constant resisting weight the weight when the leads were removed, and the additional friction for fifty-six pounds, from which that for the different weights is easily obtained.

The weight raised by this wheel was never sufficient to suspend the shaft.

Constant *inactive* weight.		
Weight of the wheel,	1600 lbs.	
Weight of that part of the chain which was between the barrel of the shaft and the drum,	264 ”	
Weight of the drum,	200 ”	
Total,	2064 lbs.	
Friction upon this at one per cent.		20.64 lbs.
Constant *resisting* weight.		
That part of the chain which was between the barrel of the shaft and the ground,	20 lbs.	
Weight of the iron basket,	126 ”	
Total,	146 lbs.	
Friction upon this at one per cent.		1.46 lb.
Friction from *constant weight*,		22.10 lbs.
The centre of gravity of the water upon this wheel, (see Fig. 3, Plate V.) was 3.02 feet from the axis, and the barrel about which the chain was wound was one foot from the same axis; hence to raise 146 lbs. and overcome a friction of 22.10 lbs., the constant friction just found, required a weight of water of	55.66 lbs.	
Friction due to this at one per cent.		.56 lb.
Total amount of friction when the weight raised was 146 lbs.		22.66 lbs.


b
d
c
c
a
c
c
Scale 1 inch to 1 foot
1
0
1
2
3

Additional friction for every 56 lbs.

Weight,	56.00 lbs.	
To balance this weight and its friction, or 56.56 lbs. required, at 3.02 feet from the axis, a weight of water of	18.73 "	
Total,	74.73 lbs.	
Friction upon this weight at one per cent.		.75 lb.

The details in relation to wheel No. III. were as follow.

The diameter of the wheel was ten feet, the breadth twenty inches, being sixteen inches in the clear between the cants which were six inches deep.

The buckets applied were of the elbow form, the depth being twelve and one quarter inches, the width of elbow three inches, and the opening at the throat two inches. The number of buckets was thirty-four.

There were no air vents in the buckets.

This wheel was used only as an overshot wheel. Two chutes were placed near the top of the wheel, (see Plate VII.) They were so situated in relation to each other, that when a bucket had just ceased to receive water from the one, it began to receive the water discharged by the other. The inclination of each chute to a tangent to the wheel, drawn through the point at which one side of the chute if produced would cut the periphery of the wheel, was the same. The object of providing the two chutes, was to determine the relative effects of one aperture of a given area, and of two apertures the sum of the areas of which should be equal to the area of the first, all other circumstances being the same. These experiments were suggested by observing that the narrow throat of the elbow buckets prevented their filling in the time of passing one chute, the air in the bucket having no other vent than the passage through which the water entered.

The gates used at these chutes are represented in Plate VII, where *a* and *b* are the chutes, and *c* and *d* are the sliding gates closing the chutes. The dimensions of the parts will be seen from the scale attached to the drawing.

A reference to the tables will show that this wheel was used both with and without a breast, and that in each case the general order of the experiments was similar to that followed in the cases of the other wheels.

The breast extended to the height of three feet and a half above the lowest point of the wheel.

The tables will be designated by the Roman numerals. The experiments made with the wheel close to the breast will be contained in table I, parts 1, 2, and 3. Those with the wheel removed from the breast in table II, parts 1 and 2.

Under the heading "Width of aperture," will be found two columns for the purpose of entering the widths of opening when both the chutes were used.

The height through which the weight was raised, as in wheel No. II, was exactly forty feet.

TABLE I.—PART 1.

WHEEL No. III.—*Elbow Buckets. Close Breast. Water let on at top of wheel.*

No. of Exper't.	Head of water above.			Width of Aperture		Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.	a	b													
	Feet.	Feet.	Feet.	In.	In.	Pds.	Pds.	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.					
1	0.25	0.50	1.10		1.50	146	22.67	168.67	40.0	31	6.13	800	10.5	84000	67468	.803		
2						174	23.04	197.04		39	4.87	925		97125	78816	.811		
3						188	23.22	211.22		42	4.52	985		103425	84488	.817	.817	
4						202	23.41	225.41		46	4.13	1055		110775	90164	.813		
5						257	24.14	281.14		54	3.52	1330		139650	112456	.805		
6	0.75	1.00	1.60		1.50	257	24.14	281.14	40.0	27½	6.91	1290	11.0	141900	112456	.792		
7						313	24.88	337.88		34½	5.51	1550		170500	135152	.792		
8						341	25.25	366.25		36½	5.20	1645		180950	146500	.809	.809	
9						388	25.87	413.87		41½	4.57	1900		209000	165548	.792		
10	1.75	2.00	2.60		1.00	257	24.14	281.14	40.0	26	7.31	1255	12.0	150600	112456	.746		
11						285	24.51	309.51		27	7.04	1370		164400	123804	.753		
12						313	24.88	337.88		27½	6.91	1500		180000	135152	.751		
13						341	25.25	366.25		32	5.94	1610		193200	146500	.758	.758	
14						360	25.51	385.51		33	5.78	1710		205200	154204	.751		
15						388	25.88	413.88		34½	5.69	1845		221400	165552	.747		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE I.—PART 2.

WHEEL NO. III.—*Elbow Buckets. Close breast. Water let on at top of wheel.*

No. of Exper't.	Head of Water above.			Width of Aperture		Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.	a	b													
	Feet.	Feet.	Feet.	In.	In.	Pds.	Pds.	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.					
16	2.75	3.00	3.60	0.50	0.50	285	24.51	309.51	40.0	26½	7.18	1315	13.0	170950	123804	.724	.724	
17						299	24.69	323.69		28	6.79	1380		179400	129476	.721		
18	2.75	3.00	3.60	0.56¼		257	24.14	281.14	40.0	22½	8.45	1245	13.0	161850	112456	.695		
19						285	24.51	309.51		25½	7.45	1315		170950	123804	.724	.724	
20						299	24.69	323.69		28	6.79	1390		180700	129476	.716		
21	2.75	3.00	3.60	0.62½		271	24.33	295.33	40.0	24	7.91	1305	13.0	169650	118132	.696		
22						285	24.51	309.51		25	7.60	1335		173550	123804	.712		
23						313	24.88	337.88		26½	7.18	1445		187850	135152	.719	.719	
24						341	25.25	366.25		30	6.33	1570		204100	146500	.717		
25						360	25.51	385.51		30	6.33	1660		215800	154204	.714		
26						402	26.05	428.05		33	5.78	1870		243100	171220	.704		
27	2.75	3.00	3.60		0.75	202	23.41	225.40	40.0	21½	8.84	1075	13.0	139750	90164	.645		
28						230	23.78	253.78		24½	7.76	1125		146250	101512	.694		
29						257	24.14	281.14		25½	7.45	1240		161200	112456	.697	.697	
30						285	24.51	309.51		28	6.79	1370		178100	123804	.695		
31	2.75	3.00	3.60		1.00	341	25.25	366.25	40.0	26½	7.17	1675	13.0	217750	146500	.672		
32						374	25.69	399.69		30½	6.23	1800		234000	159876	.683		
33						388	25.87	413.87		30½	6.23	1855		241150	165548	.686		
34						402	26.05	428.05		31	6.13	1910		248300	171220	.689	.689	
35						430	26.42	456.42		33	5.78	2050		266500	182568	.685		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE I.—PART 3.

WHEEL NO. III.—*Elbow Buckets. Close Breast. Water let on at top of Wheel.*

No. of Exper't.	Head of water above.			Width of Aperture		Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.	a	b													
	Feet.	Feet.	Feet.	In.	In.	Pds.	Pounds	Pounds.	Feet.	Seds.	Feet.	Pds.	Feet.					
36	3.75	4.00	4.60	0.37½		257	24.14	281.14	40.0	24	7.92	1185	14.0	165900	112456	.678		
37						285	24.51	309.51		25½	7.60	1290		180600	123804	.685	.685	
38						299	24.69	323.69		27	7.04	1365		191100	129476	.678		
39	3.75	4.00	4.60	0.37½	0.25	313	24.88	337.88	40.0	24	7.92	1505	14.0	210700	135152	.641		
40						341	25.25	366.25		25	7.60	1590		222600	146500	.658	.658	
41						388	25.88	413.88		25	7.60	1815		254100	165652	.652		
42	3.75	4.00	4.60	0.50		285	24.51	309.51	40 0	24	7.92	1320	14.0	184800	123804	.670		
43						313	24.88	337.88		23	8.26	1425		199500	135152	.677		
44						341	25.25	366.25		27½	6.91	1530		214200	146500	.684	.684	
45						355	25.43	380.43		26½	7.18	1625		227500	152172	.669		
46	3.75	4.00	4.60		0.62½	257	24.14	281.14	40.0	28	6.79	1275	14.0	178500	112456	.631	.631	
47	3.75	4.00	4.60		0.75	257	24.14	281.14	40.0	22	8.64	1310	14.0	183400	112456	.613		
48						285	24.51	309.51		24½	7.92	1360		190400	123804	.650		
49						313	24.88	337.88		26½	7.18	1440		201600	135152	.670	.670	
50						341	25.25	366.25		29	6.44	1575		220500	146500	.664		
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE II.—PART 1.

WHEEL NO. III.—*Elbow buckets. Without Breast. Water let on at top of wheel.*

No. of Exper't.	Head of water above.			Width of Aperture		Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.	a	b													
	Feet.	Feet.	Feet.	In.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.					
1	0.25	0.50	1.10	1.50		146	22.66	168.66	40.0	38	5.00	960	10.5	100800	67464	.669	.669	
2					1.50	146	22.66	168.66		42½	4.47	1000		105000	67464	.642		
3						174	23.04	197.04		48	3.96	1125		118125	78816	.667		
4						188	23.22	211.22		50	3.80	1200		126000	84488	.670	.670	
5				0.75	0.75	188	23.22	211.22		42½	3.80	1175		123375	84488	.684		
6						216	23.59	239.59		55½	3.80	1320		138600	95836	.692	.692	
7	0.75	1.00	1.60		1.50	216	23.59	239.59	40.0	25½	7.55	1160	11.0	127600	95836	.751		
8						257	24.14	281.14		29½	6.44	1350		148500	112456	.757		
9						285	24.51	309.51		32½	6.04	1450		159500	123804	.776		
10						313	24.88	337.88		34½	5.51	1575		173250	135152	.780	.780	
11						341	25.25	366.25		37	5.13	1725		189750	146500	.772		
12				0.75	0.75	285	24.51	309.51		31	6.00	1490		163900	123804	.755		
13						313	24.88	337.88		32	5.94	1620		178200	135152	.758	.758	
14	1.75	2.00	2.60		1.00	257	24.14	281.14	40.0	25½	7.55	1310	12.0	157200	112456	.715		
15						313	24.88	337.88		33	5.78	1550		186000	135152	.726	.726	
16						360	25.51	385.51		34½	5.51	1800		216000	154204	.714		
17				0.50	0.50	360	25.51	385.51		31½	5.43	1705		204600	154204	.754	.754	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE II.—PART 2.

WHEEL No. III.—*Elbow Buckets. Without Breast. Water let on at top of Wheel.*

No. of Exper't.	Head of water above.			Width of Aperture		Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.	a	b													
	Feet.	Feet.	Feet.	In.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.					
18	2.75	3.00	3.60		1.00	360	25.51	385.51	40.0	29	6.55	1775	13.0	230750	154204	.668	.668	
19	2.75	3.00	3.60	0.50	0.50	360	25.51	385.51		26½	7.17	1690		219700	154204	.702	.702	
20	3.75	4.00	4.60	0.75		341	25.25	366.25	40.0	22	8.45	1600	14.0	224000	146500	.654	.654	
21	3.75	4.00	4.60		0.75	360	25.51	385.51		33	5.68	1825		255500	154204	.604	.604	
22	3.75	4.00	4.60	0.37½	0.37½	360	25.51	385.51		30	6.33	1625		227500	154204	.678	.678	
23						341	25.25	366.25		27	7.04	1570		219800	146500	.667		
24	3.75	4.00	4.60	0.50		257	24.14	281.14		21	9.05	1300		182000	112456	.618		
25						285	24.51	309.51		22	8.64	1400		196000	123804	.632		
26						313	24.88	337.88		24½	7.76	1470		205800	135152	.656		
27						341	25.25	366.25		25½	7.45	1550		217000	146500	.675	.675	
28						374	25.69	399.69		25	7.60	1725		241500	159876	.662		
29	3.75	4.00	4.60	0.37½		257	24.14	281.14		25	7.60	1210		169400	112456	.664		
30						285	24.51	309.51		24	7.92	1300		182000	123804	.680	.680	
31	3.75	4.00	4.60	0.37½	0.25	313	24.88	337.88		24	7.92	1485		207900	135152	.650	.650	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

[TO BE CONTINUED.]

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Reply to the further remarks of Mr. Espy on the application of water upon wheels.

Gentlemen,—In the number of this Journal for May last, (No. 5, vol. ix.) are contained certain remarks by Mr. J. P. Espy upon my notice of a critique made by him upon a paper over the signature "L. M." In the course of his remarks Mr. Espy has *conditionally* corrected what I then pointed out as an error which his critique upon "L. M." contained. The condition is, that the "supposition" be erroneous "that water, or any other heavy body, produces the same mechanical effect by moving with a uniform velocity downwards the same distance whatever its velocity may be:" he does not show, however, nor am I able to perceive, how the truth of this supposition (which I hold to be undeniable,) can be made to sustain what he then stated in effect, viz. That when the "velocity of water in the required direction is five and a half feet, immediately on striking the wheel it receives an additional velocity of six and a half feet by a force due to a head of eight inches." I therefore assume that he has not admitted and corrected the error into which I supposed he had "*inadvertently* fallen."

Mr. Espy's mode of using time, instead of space, as an element in his calculations, does not appear to me to be correct, and I must, therefore, reject as erroneous the result at which he arrives, viz. that the whole loss of power will be forty-one inches. On the contrary, if it be admitted that when the water strikes the soaling at an angle of forty-five degrees, the motion (five and a half feet,) in the direction of the radius of the wheel is destroyed, "L. M.'s" calculation would be right. The result of this calculation is a loss of head of thirty-three and one-third inches, instead of forty-one inches as given by Mr. Espy. I do not, however, admit the destruction of the whole of the velocity in the direction of the radius of the wheel, and will endeavour to show that it is *chiefly* changed to the direction of the tangent.

Mr. Espy says, "if we suppose the water and the soaling both perfectly elastic, the water upon striking the soaling would rebound, making the angle of reflection equal to the angle of incidence; and the velocity in the direction of the tangent would evidently remain the same. If we suppose the water and the soaling both perfectly hard and smooth, upon striking the soaling, the motion of the water in the direction of the radius of the wheel would be entirely destroyed, whilst that in the direction of the tangent would remain the same." The first of these propositions I fully admit; but, as the water does not possess the property of perfect elasticity, the angle of reflection will not be equal to the angle of incidence. The last proposition I will neither affirm nor deny, inasmuch as having no materials which are perfectly hard, no experiments have been, or can be made, to prove what would be the result if such materials could be found and used for the purpose. But I admit that, if instead of the water and the wheel, solid and non-elastic substances, such as do exist, however hard, (none being so hard as to resist a change of form on collision,) were used, the motion in the direction of the radius would be destroyed, and that in the direction of the tangent remain the same. This destruction of motion, however, cannot be effected without the result of a change of form of one or both of the substances thus brought into collision, and the quantity of power expended in the change, will be equal to the quantity of motion or power destroyed. For example, suppose a leaden ball of two pounds be let fall from a height of 100 inches on a hard* non-elastic horizontal plane, and the lower side of the ball be indented, or bruised, so that its mass be brought one inch nearer the plane than where it first struck, the space through which the mass would have passed after contact, would, of course, be one inch, the mean degree of the force of collision would be found as follows: as 100 inches, the distance through which the ball descended, is to two pounds, the force by which it was impelled, so is one inch to 200 pounds, the medium force by which the ball would have been resisted in its collision with the plane; and in like manner if a similar ball be projected against the soaling of a wheel supposed to be hard and non-elastic, the figure of the ball would be changed, and the *quantity* of resistance in the change would be equal to the *quantity* of motion or power destroyed. The result will be very different, however, if water be used instead of the leaden ball, which must be apparent to every person of the slightest observation. Suppose two pounds of water be let fall upon a plane; portions of it will be driven off nearly in the direction of the plane, radiating from the point of impact, at a velocity but little diminished: this velocity must be derived from, or rather is a part of, the original motion, the direction of which has been changed by striking the plane. Had this been a perfectly elastic body it would have rebounded perpendicularly to the height from which it originally fell; had it been a leaden ball its particles would have been prevented by cohesion from flying off, as in the case of the water, consequently its whole motion would have been destroyed by the change of figure, or, in other words, by friction occasioned by the particles pressing upon each other with great force in this movement among themselves. With regard to the water, although its original figure suffers a greater change, yet the frictions *consuming the motion* are diminished, the particles being pressed with less force against each other. Thence, in the case of the lead, the motion was all destroyed, and only part of it in that of the water; what remains in this latter case would, of course, be capable of producing mechanical effect.

This explanation applies to the action of the wheels at Fair Mount, which receive the impulse of the water at an angle of forty-five degrees. We are, therefore, not to expect the motion in the direction of the radius of the wheel to be wholly destroyed, but on the contrary only a small portion of it, because the water will be less agitated, or, what is the same thing, the particles will be less moved among themselves than in the case where it fell perpendicularly upon a plane. Thus the water will move off nearly in the direction of the tangent with no other loss of motion than that occasioned by a comparatively small agitation. It is evident, then, that a change of direction, without a corresponding destruction of motion, is not repugnant to any law of nature, and that when it cannot be effected without loss, it must be attributed to the materials made use of, or to the manner of applying them.

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* Hard, is here used comparatively.

Having, as I believe, shown with sufficient clearness that a change of direction may take place under the circumstances in which water is used at Fairmount, without a proportionate loss of motion, it is deemed unnecessary to extend this paper in review of Mr. Espy's deductions from the known laws of action and reaction, &c. His proposition for substituting time instead of space, as an element in determining the power of water, is to me so mystical, that I confess I cannot, or rather, that I have not yet been able to, understand his illustrations in support of it, and must therefore pass it by for the present.

I would be indulged in a few observations upon a subject introduced by Mr. Espy. This subject refers to a former controversy regarding the laws of momentum, in which Mr. Espy maintains, that momentum is proportional to the velocity of a body, and not proportional to the square of the velocity, for which latter law he says I contended.

It will be necessary first to state that I understand the word momentum, to mean the power or capability of a body in motion to produce a mechanical effect by virtue of that motion. For example, if a heavy wheel be in motion, its power to raise a weight by means of a cord connected with its axis, I deem to be the measure of its momentum, the quantity of which may be found by multiplying the weight by the height through which it has been raised. This supposes the wheel to be free from all other resistances. If Mr. Espy's understanding of the term be different from this, our difference in opinion may relate to the meaning of the word momentum alone. With this explanation, I will proceed to apply the theory for which Mr. Espy says I have contended, to a case which he appears to rely upon with the utmost confidence as conclusive in support of a different one. He says, "let two non-elastic bodies, of different masses, meet each other in opposite directions, with velocities inversely proportional to their masses, the momentum of each will be destroyed, for after the stroke there will be no motion." The principle of action here is identical with that of the leaden ball noticed above, and the quantity of power destroyed by the collision is to be found by multiplying the space through which the bodies pass respectively whilst in collision, by the degree of force by which they resist each other. Suppose the masses in motion, and their velocities inversely, to be as one to two, and the velocity of the smaller body to be sixty-four feet, and that of the larger body thirty-two feet per second; then according to the second theory above stated, the momentum of the first may be thirty-two, and the latter sixteen. Suppose that in the collision they bruise each other so that the centre of their masses be brought three inches nearer to each other than their unaltered form would have admitted, their united momentum, after collision, will be less than before collision by the effect due to a resistance acting through three inches of space, and as "action and reaction are equal," both will be resisted by precisely the same degree of force, but as the smaller body moves with double the velocity of the larger, and both come to rest at the same instant, the first will pass through two inches, the latter through but one inch, after they come in contact. The mean degree of force will be sixteen, which, multiplied by the space two inches, give thirty-two as the quantity of resistance which brought the smaller body to rest, and the larger body being resisted by the same degree of force, to wit, sixteen multiplied by one, the space through which it was resisted, the product is sixteen, which is the momentum destroyed in the large body. As this result appears to be at variance with Mr. Espy's notion of the equality of action and reaction, which is true in *degree*, but not in *quantity*, it may be further illustrated by a very familiar case.

Suppose a gun be discharged, projecting a ball with a momentum capable of perforating a plank two inches in thickness, I believe it will not be contended by any that if a similar ball were attached to the breech of the gun in such manner as to be forced by its recoil against a similar plank, that the latter also would be perforated. The law here is the same as in the case of the smaller and larger bodies noticed above, the action of the powder on the ball would exert a force reacting in an opposite direction and equal in *degree* against the gun, but the *quantity* of force that would be communicated to each, will be as the force multiplied by the space through which the ball and the gun would respectively pass, whilst the force of the powder continues to act on either.

Very respectfully, yours, &c.
C.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.*

On the method of Embalming by the Egyptians, and the Preservation of Dead Bodies from Decay.

It is an established fact in the history of science, that the Egyptians were the first people to rear up the fair temple of knowledge for the abode of those abstract and interesting studies which even at the present day remain sealed to the larger portion of mankind. The sciences of astronomy, the yet more subtle pursuit of astrology, architecture, painting, and medicine, connected with some portion of practical chemistry, were undoubtedly pursued with an avidity as surprising as they were prolific of discovery: and posterity acknowledges the wondrous strength of mind that could force intractable materials to a common purpose, without the aid of the extraordinary adaptation of power which is at our command. It would be an interesting task to explore the route of science by the Egyptian way; to track the god-like spirit of intelligence through an æra, dreary and darkened in other respects by the errors of superstition; to follow the beams that emanated from one celestial principle, guiding the will through mazes of doubt, until the light of science burst upon the view; and it would be equally instructive to institute comparison between an ancient and a modern literature, with an intention of ascertaining how far we have retrograded in some instances, and how far we have in others advanced in the pursuit of many of the sciences, and in the cultivation of many of the arts: but, under the title of these remarks, we may not extend our researches beyond the limits of our inquiry, nor is it necessary for the confirmation of the assertion of the skill of the Egyptians, since that one inquiry will display it, not only in a remarkable, but in an inimitable degree. We allude, of course, to the method pursued by that nation in the preservation of their dead by the process of embalming.

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* Addressed to the Committee on Publications, and by them inserted.

It was the belief of the Egyptians that the soul was eternal, but that after the death of the body, it migrated into the various tribes of beings in the earth, air, and water, and once more returned, after an absence of three thousand years, to animate the structure of man. The first change was believed to take place only when the process of corruption was complete, the soul remaining attached to the frame in a state of somnolence so long as the remains of humanity were visible; from this supposition arose the idea of preserving the body from putrefaction for an indefinite period, in order to chain the soul, as it were, to its former abode, and render its flight to other receptacles less rapid, and its changes of less variety. Thus no expense or exertion was spared to stay the progress of putrefaction, no labour withheld in the erection of those majestic fabrics destined for the reception of the bodies yet presumed to retain the silent spirit; and the fortunes of survivers were readily bestowed in the completion of what were termed eternal mansions, while their own dwellings, denominated inns, or resting places, from the short sojourn of the travellers within them, were left comparatively unadorned.

Upon the decease of a person of consequence, the females of his household, and his acquaintances, covered their heads and faces with clay, bared their bosoms, and girt their waists with coarse cloths, and, leaving the body in the dwelling, perambulated the city, uttering loud cries, bewailing the loss of the dead, and describing his qualities, at the same time violently beating their persons. The men, in like manner, formed another company, and pursued a similar mode to testify their grief, all rigidly abstaining, until the interment of the corpse, from the use of the bath, from wine, from the better descriptions of food, and the use of fine apparel. The body was, in the course of a few days, removed to the embalmers, who having performed their office, returned it to the relatives. It was then placed in a coffin of a shape like the human figure, and in general placed upright in the receptacle designed as a tomb. Sometimes by the exercise of a singular species of piety, the corpse was kept in the dwelling of the surviving friends, in a magnificent apartment, prepared for its reception, and in some instances, the embalmed body was carried as a guest to the tables of friends.

We are told by Herodotus and Diodorus Siculus that the art of embalming was practised in three different modes; the first, required only in preserving the bodies of kings or nobles of the highest rank, cost a talent of silver,* and was thus conducted. The brains were first drawn out through the nostrils by a curved instrument, and the cavity filled with spices. An officer, termed a Scribe, then drew a line on the left side of the abdomen, where an incision was to be made, which was exactly followed by a menial called the Paraschistes, with a sharp Ethiopian stone; this done, he immediately retired to avoid the execrations and violence of the bystanders, who sought in this manifestation of their indignation to ward off the curse which they presumed to await them in permitting a wound to be inflicted upon a dead body.

The office of the embalmers now commenced; one of them thrusting his hand through the wound, drew out the intestines, leaving the heart and kidneys. The abdomen was then filled with pounded myrrh, cassia, and other sweet smelling drugs, frankincense alone excepted, and the incision being closed, was carefully sewed up; the body was immediately rubbed over with oil of cedar, and other preparations, for thirty days successively, or otherwise it was soaked in a strong solution of nitre for seventy days, the longest time allowed for the preparation of the body. At the expiration of this time, the body was carefully washed, and wrapped round with strips of fine linen in every part, which was afterwards covered with a gummy substance.

These arrangements were all performed with the utmost nicety, the hair of the head and the eyebrows were uninjured, and even the features so little disturbed as to permit the recognition of the individual years after his embalmment, in those cases where he was detained from the sepulchre. The second mode was much more simple, and consisted in injecting oil of cedar into the bowels, by the rectum, retaining it there, and placing the body in a solution of nitre, as before, for seventy days; the injection was then allowed to escape, bringing with it the entrails, which the oil had in a great measure consumed. The body was then delivered to the friends without any further preparation.

The third method, which was adopted for poor persons, consisted in merely injecting into the stomach and bowels some preparations of less value than the oil of cedar, and soaking the body in a nitrous solution.

The coffins, or cases, in which were put these preserved bodies, or mummies, as they are styled by the Arabs, and from whom we have borrowed the term, were usually made of sycamore wood, which possesses extraordinary durability; the top was formed in the shape of a human head, with a face painted thereon, resembling that of a female: the trunk was one continuous piece, made very thick, with a broad pedestal at the bottom, to enable it to stand upright in the tomb. In some few instances, a stone coffin has been discovered, presenting the same shape, and, in still rarer cases, the covering of the body has been found of cloths gummed or fastened together, and constructed in the usual form.

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* About $1100.

Upon the examination of a mummy, we find it wrapped in a shroud of linen, or rather a finer fabric than canvass, upon which are secured scrolls of the same material, painted with a variety of characters, and generally running down the centre of the body and sides, or placed on the knees or legs: the head is fitted with a piece of linen, the feet have likewise a similar covering, painted with hieroglyphics, and fashioned in the form of a high slipper. The whole body is swathed with narrow bands of linen, beginning at the head and ending at the feet, to the almost incredible length of upwards of one thousand ells upon one corpse; and those in particular which cover the head and face are so neatly laid on as scarcely to disguise the shape of the eyes, nose, and mouth.

On the breast, are folds of linen cut in a scalloped form, as if to answer the purpose of a breast plate, and which are usually richly painted and gilt, sometimes bearing the figure of a woman with the arms extended. Within the body are found masses, of the colour, scent, and consistence of pitch, or bitumen, which are readily affected by heat; and upon the examination of one body in England, it is recorded that about two pounds weight of this substance was found in the cavity of the skull. The piece of coin that was supposed to be placed in the mouth of the corpse has been looked for in vain, although a small plate of gold of trifling value has been occasionally discovered under the tongue. The hands are sometimes stretched upon the thighs, but more commonly folded across the bosom; the skin blackened, and usually attacked in some parts by a peculiar kind of coleopteral insect, and the hair perfect.

The heart, and, in some instances, other viscera, are found in a dried but perfect state of preservation, and the whole frame is remarkable for its lightness and rigidity.

An opinion has prevailed that the Egyptians possessed the power of extracting the brain, and filling the cavity with a bituminous composition, without mutilating any of the bones of the skull; but this is hardly practicable.

The nostrils offer the only medium through which the brain could be removed without visible marks of injury, and the delicate structure of the cribriform plate of the ethmoid bone would be destroyed by the application of the slightest violence. In all the examinations witnessed by the writer, a probe was readily passed up the nostrils to the roof of the cranium, proving that the brain had been removed by those channels, and that the delicate bones of the skull had been broken down in the attempt. It will thus be seen how perfect the system adopted by the Egyptians for the preservation of their dead was rendered; their work is before us, unattainable to our execution, existing in its pristine excellence, and capable of yet enduring for an illimitable extent of time. And so of many other pursuits: we can scarcely conceive the ability that could raise so ponderous a mass as the pyramid of Cheops, which might well be termed an eternal mansion, since it has endured so long with the finger of time laid so lightly upon it, as not to have injured its fair and magnificent proportions: and it is equally difficult to imagine, how, in the dearth of correct knowledge, and the want of scientific material, conclusions could have resulted from observations of heavenly bodies so closely allied to truth, as to have assisted in the construction of a solar system, in some respects resembling that upon which our astronomical calculations are founded.

The art of embalming, as practised by the Egyptians, may be said to have expired with them as an ancient nation. In continental Europe, in England, in Teneriffe, South America, Otaheite, and other islands in the southern ocean, processes have been adopted for preserving dead bodies from decay, and in some situations, the soil in which the body has been placed, has acted as the antiseptic agent in staying the progress of putrefaction. Gough, in his sepulchral monuments of Great Britain, observes, when speaking of embalming, "that Henry 1st, in 1135 was gashed, salted, and sewed up in a bull's hide, after his bowels, tongue, heart, eyes and brains had been taken out." This uncouth mode of embalming appears to have been practised in England for a considerable period, although the hide was soon laid aside in favour of cloth, and sometimes of silk or satin coverings, and to have been especially in request to preserve the bodies of sovereigns, and the higher orders of ecclesiastics. Edward 1st, buried in 1320, and found in a state of tolerable preservation in 1714, is said to have been the first monarch upon whom the practice of cering was tried, an operation performed by the Court chandler, and consisting merely in enfolding the royal body in a waxed cloth or silk, after the removal of the viscera. This custom continues to the present time, and is extended to all the members of the royal family.

The remains of Edward the Confessor; of Fair Rosamond; of Maud, daughter of Henry 1st; of Thomas, Bishop of Ely, who died in 1570, and was examined in 1780; of Humphrey, Duke of Gloucester, died 1100 and examined 1747; of king Charles 1st, beheaded 1648, and examined in 1813; of Henry 8th, likewise examined in 1813, (upon the breaking in of his coffin, when restoring that of Charles 1st to its former situation,) have all been exposed, and in different states of preservation. Some of these bodies have been discovered in a species of spiced wine, and others wrapped up in vestments of different descriptions; but, in general, although the structure be not destroyed by corruption, the means adopted have been insufficient to ensure the regularity of appearance, and the preservation of every portion, so remarkable in the Egyptian process.

There are three other methods, which may be styled natural means of preservation, and by which a human body can be withheld from the operation of the putrefactive process, for a very long period of time.

We are presented with examples of the first mode, by the discovery of bodies found in the sands of Arabia, dried by the air, the external cavities filled with sand, and preserved entire, without the assistance of art. Of the second, by bodies found on the sea coast, where from long exposure to the sun, and repeated washings by the wave, they become so dry and hard, as almost to present the appearance of a fossil remain. Of the third, by bodies preserved by the peculiar properties of the soil in which they have been deposited. The circumstances under which bodies are preserved by the first two processes are sufficiently simple, and need no remark, but with the third,an event of some notoriety is connected, having too close a reference to our subject to pass unheeded.

Fourcroy relates " that the burying place ' Des Innocens,' at Paris, was opened for the purpose of removing the bodies of the poor which had been buried there in large graves, each holding from one thousand to fifteen hundred, and about thirty feet deep, and twenty feet wide. Each body was buried in a wooden coffin, and all were arranged one alongside of the other: the pit was generally filled in the course of three years, when it was covered with earth to the depth of about a foot, and in the course of from fifteen to thirty years, it was again opened for the same purpose as before. Upon the opening of these graves, and the removal of the covers of the coffins, the bodies appeared to be flattened or pressed down, a considerable space being left between their surface and the top of the coffin. Those bodies that had been buried for about fifteen years, consisted of a soft grayish-white coloured substance, of a fatty nature, bearing a considerable resemblance to spermaceti, into which every part of the body was converted, except the bones, which, being no longer retained by their former attachments, were separated by the slightest effort, they were also very easily broken, while the muscles, tendons, ligaments, blood-vessels, viscera, &c. were changed into a homogeneous mass; perfectly uniform in its texture. In those instances, when the bodies had only been buried nine or ten years, the form of the different parts was distinctly visible. It is said that this appearance is retained for thirty or forty years, when it is at length decomposed and carried away by the surrounding moisture. According to the prevailing opinion, the skin passes more readily into adipocere than any other substance, and is next followed by the muscles and viscera." After these remarks, it may be observed that when a body is interred in a soil of the nature to accomplish such results, and a large quantity of moist earth is present, the common putrefaction that animal matter underdergoes, rapidly takes place, particularly when the temperature is considerable; but if the corpse be placed in a dry situation, where the earth is exposed to the rays of the sun, and becomes quite dry, the fluids are evaporated, and it is converted into a kind of mummy. In the repositories of " Des Innocens," the bodies were excluded from the action of the external air, and left to the spontaneous reaction of their elements.

We have now examined the ancient mode of embalming by the Egyptians, the manner in which bodies were preserved by other nations at a much later period, and the processes adopted by nature in some cases in preserving her noblest work from decay. There can be little difficulty in awarding the palm of merit, as the productions of all have fallen under the inspection of man; we must confess that the Egyptians infinitely excelled in retaining the semblance of the human form, and in keeping destruction at a distance. We have thus supported the principle with which we started, that in this particular, modern ability is surpassed by the silent testimony of ancient skill.

We shall upon another occasion endeavour to trace the meanings and the references conveyed by the hieroglyphics as appearing on the cases and vestments of Egyptian mummies.

BIBLIOGRAPHICAL NOTICES AND REVIEWS.

On the Strength and Best Forms of Cast Iron Beams.

[Continued from p. 389, vol. ix.]

In pursuing the deductions from his experiments our author proceeds to compare together the deflections of beams of the new form under their breaking weights, or, in other words, seeks by comparing the ultimate deflections to determine the law of these deflections when the breadth and length of the beam are varied.

The mode of calculating the ultimate deflections would seem to subject them to errors of variable magnitude; it belongs to experiment to determine whether these may, or may not, be neglected for purposes of practical inquiry.

The method of calculation to which we refer is, to assume the deflections to be proportional to the weights producing them, even up to the breaking weight. Thus, "in experiment 11, 13706 lbs. bent the beam .52 of an inch, and 14462 lbs. broke it. As 13706 : 14462 :: .52:.55, of an inch, the ultimate deflection." The least consideration will show that after the elasticity of a beam is injured by the weight placed upon it, the deflection must increase in a greater ratio than the weight. The amount of the error introduced may be determined, not very nearly, but with sufficient accuracy to enable us to decide upon the method of calculation, by comparing some of the deflections under the later weights applied to the beams, with the deflections near the breaking point as given by experiment. In the subjoined table we have made such an examination. The first column gives the number of the experiment referred to; the second, the number of pounds which gave the observed deflection in the third; the fourth, the last weight under which the deflection was estimated; the fifth, the deflection under this weight; the sixth, the deflection calculated from the second, third, and fourth columns, supposing the deflections to be proportional to the weights; the seventh, the differences between the observed and calculated deflections; the eighth, the breaking weights to compare with the last weights (in column fourth,) under which the deflections were observed, and upon which the ultimate deflections are calculated.

No. of exp't	Weight in lbs.	Deflection observed.	Last weight for which deflection was observed.	Observed deflection.	Calculated deflection.	Difference.	Breaking weight in lbs.
11	11186	.40	13706	.52	.49	.03	14462
12	16226	.49	16730	.53	.48	.05	16730
15	15393	.33	16401	.53	.33	.20	16905
18	14345	.33	18265	.43	.42	.01	19441
20	18265	.36	22969	.50	.45	.05	23249
21	16697	.42	20617	.54	.52	.02	21009
23	10017	.80	12815	1.08	1.02	.06	13543
24	10017	.53	12087	.63	.63	.00	15129
25	12087	.45	15129	.58	.56	.02	15129
26	15913	.40	21401	.65	.54	.09	22185

It is unnecessary for our purpose to extend this table further. Two of the experiments contained in it, viz. 12 and 25, give the observed ultimate deflections for the breaking weights: the differences in all the cases are by no means so great as to require any other mode of deducing the ultimate deflection to be resorted to.

The conclusions which are deduced from comparing the ultimate deflections of beams having nearly the same ratio of top and bottom rib, are not based upon an amount of experiment which *commands* our assent. To conclusion that the "deflections are as the depths; for the products of the depths and deflections were equal in the two experiments, since $4.1 \times 1.14 = 6.93 \times .67$ very nearly," is derived, directly, from only two experiments, viz. 23 and 26. It, however, is supported by other experiments less directly to the point, and has been shown for the material generally by other experimenters.

The next conclusion contradicts the generally received law of deflection while the elasticity remains perfect, and goes to establish that the ultimate deflections are more nearly as the lengths than as the squares of the lengths. We give the author's reasonings upon this subject.

"2nd. For the ultimate deflection in terms of the length. The mean deflection of the beams in experiments 15, 18 and 20, (in which the span was four feet six inches, and depth five and one-eighth inches,) was .51 inch; and in experiment 24 (where the span was seven feet, and the depth 5.2 inches, nearly same as the others,) the deflection was .79 inch. Hence the ultimate deflection in these was simply as the length; for 4 feet 6 inches : 7 feet : : .51 : .79 inch.

Supposing the ultimate deflections to be inversely as the depth when the length is the same, if we reduce the deflections in experiments 23 and 26, to what they would have been if the depth had been five and one-eighth inches, the deflections from both these would have been .91; for $\frac{1.14 \times 4.1}{5\frac{1}{8}} = .91$ and $\frac{6.93 \times .67}{5\frac{1}{8}} = .91$. The lengths of the beams here being seven feet, as in experiment 24, the deflections are about one-seventh higher than .71, the quantity which we have just found they should have been, if the deflections had been as the lengths. Comparing likewise the length and deflection in experiment 28 or 31 with those in experiment 32, where the depth was the same, we find that double the length gave there more than three times the deflection.

"From these different experiments we find that the ultimate deflections are in a higher ratio than as the lengths, but are not as the square of the lengths, as is generally assumed.

"3d. The ultimate deflections, we see, are in a ratio somewhat higher than as the lengths; and comparing those in experiments 30 and 33, with that in experiment 32, they appear sometimes to increase faster than the depths decrease. If, however, the ultimate deflections were directly as the length and inversely as the depth, or were higher than in both of these ratios in an equal degree, we should conclude that a beam of double the length and depth of a given one would ultimately be deflected the same quantity as it. To see how this accords with the experiments, we will take the short beams, in experiments 28 and 31, and compare their deflections with those from the beams of double their length and depth in experiments 30 and 33; the ultimate deflections from the small beams were .56 and .59 inch respectively, and those from the large ones were .64 and .63 inch. Whence it appears, that the deflections were nearly, but not precisely, equal; there being, in both cases, a deflection somewhat greater in the larger beam."

Further experiments seem to be wanting to establish this point.

B.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JANUARY, 1832.

With Remarks and Exemplifications, by the Editor.

1. For a *Cement for Wood, Brick, Stone, and Iron Work;* Richard Walsh, Boston, Massachusetts, January 5.

This cement is to be made by mixing together one quart of ground lime, two of calcined plaster, and three of Roman cement. To these are to be added two pounds of black lead, one quarter of a pound of red lead, and the same quantities of copperas and of litharge.

These ingredients are to be incorporated in boiled linseed oil and spirits of turpentine, in the proportions of one part of the former to two of the latter; and it is said that when brought to a proper consistence for spreading, this preparation will afford a slate coloured cement, calculated to defend the material upon which it is laid from the action of the weather. The colour may be varied by mixing with the other materials any suitable colouring ingredient.

When we read the title of this patent, we expected to meet with a cement for uniting substances together, and not with a mere paint for spreading over surfaces in the ordinary way. As a paint, the composition is rather heterogeneous; some of the substances named may be left out without any disadvantage, or others may be added without abstracting from the good qualities of the mixture. The patent, however, is taken for the precise compound, and such as it is, those who use it, must purchase a right, or invade the claims of the patentee.

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2. For an improvement in the *Mill Stone for grinding grain;* David Stem, Mechanicsville, Vanderburgh county, Indiana, January 5.

This grist mill is to act upon the well known principle of many paint mills. The runner is to be a cylinder, revolving horizontally, and the bed stone a hollow segment in which it fits, the stones being furrowed in a suitable manner. The bed stone is to be borne up against the cylinder laterally, and the feeding regulated by their greater or less distance apart. There is no claim made, nor is there much room for one.

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3. For an improvement in the *Fanning Mill;* Samuel Fitch, Otsego county, New York, January 6.

The *improvement* here offered consists in putting an eccentric wheel upon each end of the shaft of the revolving fan, which wheels act upon levers, giving motion to the shoe, "which motion is necessary to the cleaning of grain." No more.

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4. For an improved machine for *Breaking and Dressing Hemp and Flax;* Ebenezer C. Chase, Jay, Oxford county, Maine, January 6.

A cylinder four feet in diameter, and two feet long, is to be fluted from end to end, all round, so as to form it into teeth. A block of wood is to be placed above this: this block is to be a cube of two feet on each side, excepting that the bottom is to be hollowed to suit the cylinder, and it is also to be fluted in such a way that its projecting angles, or teeth, may fit into the spaces between those on the roller. The cylinder is to be made to revolve, and to act upon lifters which raise the block, in order to its falling upon the hemp or flax which is to pass between it and the roller. There is a feeding apron upon which the flax or hemp is to be laid, and a delivering apron to conduct it off after it has been operated upon. There is no claim made.

This machine very much resembles the ordinary Dutch brake in its mode of operation, although it differs much from it in form; we do not perceive how it is calculated to do the work better, or with greater facility than many other machines which have been made.

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5. For an improvement in the *Tin Bake Oven;* William Lewis, Franklin, Delaware county, New York, January 6.

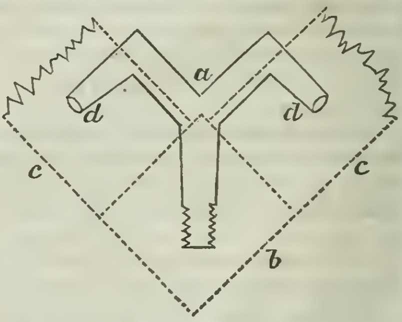
The top and bottom parts of this tin oven are to be formed into regular flutes from front to back, in order to reflect the more heat upon the substance to be cooked; there is also to be a reflecting piece along the front. The sides are to flare out a little, like a Rumford's fire place; the dripping pan is to rest upon three wires crossing the oven, and upon each of its ends there is to be a handle; the whole, so made, constitutes the patent oven.

6. For an improved *Machine for Cutting Books;* Archibald O. Douglass, city of Philadelphia, January 6.

This cutting press is intended to accomplish the same purpose with that described at page 234 of the last volume; that is, the book is to be supported upon a platform which is capable of being raised or lowered at pleasure, to suit the length and width of the volume; the means of adjusting, as well as many other things in this press, differs however, from that alluded to, as well as from the common cutting press. The patentee calls this a box press, which name it receives from there being side and end pieces strongly framed together, and consisting of thick plank like that used for the cheeks in other cutting presses. Through one of these sides, work the wooden screws which force up a sliding cheek to hold the books; and round the heads of the screws a strap passes which is to operate as a band to cause one of them to turn by turning the other. Whatever may be the general good properties of the press, we are confident that this band will not accomplish the object for which it is intended; this, however, is a point of little importance. The manner of fixing the plough, and of adjusting the various parts, we cannot attempt to describe without a drawing.

7. For an improvement in *Bedsteads;* Cornelius Vannoy, Lexington, Fayette county, Kentucky, January 10.

Two improvements are here proposed; one of them, in the mode of fastening the rails to the posts, the other in the mode of tightening the sacking bottom. One of the methods proposed for fastening the rails, is similar to such as have been long in use, consisting of a piece on the end of the rail, which passes into an opening on the post, so that by turning the rail they are fixed together by the wedging of the pieces. There is another method stated, which appears to be new. A cast iron hold-fast is to be made in the form of *p*, which is to have its shank fastened into the post *b*. The two hooks, which stand nearly at right angles with each other, are to fit into holes bored in the insides of the rails *c c*. The hook parts *d d* stand a little wedging, and when the rails are driven on to them, their ends, which are worked off square and smooth, are drawn up against the post.



Although this plan is new, we do not think it superior to others previously in use; indeed, we believe that a well made bedstead, with good screws, fitting indiscriminately, is to be preferred to most of the patented fastenings.

The modes of cording the sacking bottoms do not offer any thing particularly worthy of attention, not being better than former plans.

8. For a mode of *Restoring sour, stale, or musty Ale, Beer, or Porter*, to their original flavour and purity, by the operation of re-brewing; Moses Granger, Louisville, Louis county, New York, January 11.

A mash is to be prepared in the usual way, and the wort drawn off from it. To the malt grains which remain, the sour ale, or beer, is to be added, say to the amount of sixty gallons to forty bushels of grains, and drawn off. This liquor is to be boiled with hops, in the proportion of half a pound to a barrel, after which it is to be put into a clean vessel, and kept for mashing at a subsequent brewing, which, we are told, will restore the liquor to its former state of sweetness and purity.

9. For an improvement in *Locks;* James Meneely, Watervleit, Albany county, New York, January 12.

All that is claimed by the present patentee is the making the box of the lock, and all the necessary upright pieces within it, of cast iron; the staple or catch, with the necessary screw holes, are also to be cast, as are the bolt, the screw, the key holes, and the wards. For the doing of this, an exclusive privilege is demanded; the claim to *novelty* and *invention*, rests insecurely on such a basis, or we are mistaken in our views of the patent law.

10. For an *Ice Steam-boat*, for clearing harbours, &c. of ice; Robert Irvine, city of Baltimore, January 12.

Many trials have been made with differently constructed ice breakers, to be worked by steam, but it has been found more difficult to accomplish the object practically, in a harbour or river, than had been anticipated in the parlour. In the plan now proposed we do not see any thing likely to remove the difficulties.

When ice has acquired a considerable thickness, to break and get it out of the way of the boat and paddle wheels, is a very slow process; and to construct and keep a machine in readiness for this purpose alone, requires more remuneration than the few occasions for its employment would be likely to afford.

In the plan before us there is to be a gang of saws in front of the boat, thirteen saws being represented in the drawing. Shanks rise from the upper ends of these saws, by which they are attached to a vibrating frame, as from the nature of the work which they have to perform they must be made sufficiently stiff not to require straining below. The shanks, we are told, should be of round iron, eight feet long, and six inches thick; the saws three feet six inches long, and an inch and a quarter thick, on their front edges.

An ice breaker, consisting of a plate of iron two inches thick, and extending the whole width of the gang of saws, is placed behind them, and the whole are to be made to vibrate by a crank shaft, acted upon by the steam engine. The saws are to make 100 strokes per minute.

Until this machine is put into operation, and has established its character by success, we deem it needless to say any thing further respecting it, excepting to promise that when this period arrives, we will repair forthwith to the scene of action and report the facts.

11. For an improvement in *Manufacturing Hats;* Joel Taylor and Charles Brown, Danbury, Fairfield county, Connecticut, January 13.

Rabbit's, or other similar fur and cotton, are to be mixed together, in equal, or other, proportions, and bowed in the usual manner of bowing fur. The bats, or flakes, are then to be wrought by rolling and planking in the usual manner; the dying, stiffening, napping, or covering, are also to be effected in the ordinary way.

The claim is to the mixing of cotton and fur, in the manufacture of hat bodies.

12. For a machine for *Dressing Mill, and other Stones;* John Keeper, Williamsport, Lycoming county, Pennsylvania, January 13.

A chisel, or cutter, for dressing the stone is fixed on to the end of a handle, which is to be raised by machinery. There is a frame which stands horizontally, and the handle, carrying the chisel, is attached to a shaft crossing this frame at about its middle, and working on gudgeons within it. A cylinder, with cams, or wipers on it, is turned by a crank, the cams acting upon the far end of the handle, lifts it like a tilt hammer, and a steel spring bearing upon the handle near the chisel, or cutter, increases its force in descending. The frame is fixed upon a sliding carriage, allowing it to move backward, forward, or laterally; and a regulating bar across the frame is made adjustable by screws, to determine the depth of the furrows.

When the stone is to be dressed it is secured in a proper position, and the machine adjusted to it. The crank handle is then to be turned, and the proper sliding motion given to the frame. The claims are to "the regulating screws, the regulating bar, and the slides."

13. For an improvement in the *Plough;* Thomas A. Whities, Bellfontaine, Logan county, Ohio, January 14.

The principal part of the specification of this plough is occupied with the admeasurement of its respective parts; and we are told that "it is composed of wood and wrought or cast iron, and steel." The manner of bracing and putting it together are particularly described; the inventor "believes that it will run much lighter than any now in use, turning over an equally large, if not a larger, furrow, and it may be used in the foulest land without choaking." To what part it is indebted for those properties which are its recommendation we are not informed, as there is no claim made, or any thing else to indicate the points of novelty.

14. For a *Machine for bending Felloes for carriage wheels;* Tristram Kimball, Salem, Rockingham county, New Hampshire, January 16.

Pieces for felloes are to be split out, and reduced to a proper size for bending, which is to be effected by the machine. A long ground sill is laid upon cross pieces, and to one end of this a lever is attached by a joint. Upon the sill, near the joint, a shaping block is to be placed; this consists of a piece of wood, the upper side of which is a curve adapted to the inside of the felloe to be formed, and above it, on the under side of the lever, is a follower, concave below, to force the felloe on to the shaping block. The lever is of considerable length, and may be loaded at its extreme end, so that its weight shall suffice to bend the felloe. On the ends of the shaping blocks there are ears, with mortices through them to receive pins, or bolts, which are to confine the felloe upon it after it is bent, allowing one shaping block to be removed, and another substituted in its place as the felloes are bent. A windlass with a rope and pulley, is attached to the lever, for the purpose of raising it. There are various props, braces, &c. which are figured and described, but which we need not notice.

The claim is to "the before described machine for bending felloes for carriage wheels."

The patentee says that the wheels made of felloes so bent, besides being cheaper, are stronger and better than any wheel heretofore constructed. Allowing this to be the case, the patent has nothing to do with wheels thus made, but merely with the machine for bending the felloes; and this may be done as readily by other methods, not interfering at all with "the before described machine."

15. For an improvement in the *Throstle Frame* for spinning cotton: Seth Simmons, Providence, Rhode Island, January 16.

We have not been able to obtain a clear idea of the details of this throstle frame, although its general structure is sufficiently apparent. There is a drawing, in perspective, very well executed as a picture, but defective in consequence of its not showing distinctly those parts upon which the merits of the invention depend.

We are are told in the specification that the improvement consists in taking the thread from the roller in the centre of the balance flyer, running it thence through the gudgeon and pulley, and then through two holes in the balance flyer, &c. &c. The spindles, instead of being placed vertically, form an angle of forty-five degrees with the horizon; they are denominated independent spindles, being so constructed as to move round either slowly or rapidly in filling the bobbin. This, if we understand the specification, is to be effected by springs of wood, which, by means of thumb screws, may be made to bear with greater or less force against each spindle. The principle claimed as original is "the method of bearing against the spindle."

If we have communicated a clear idea of this invention, the merit will belong exclusively to the reader, as our own conceptions of it are altogether confused.

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16. For an improved *Surveying Compass;* William J. Young, city of Philadelphia, January 17.

The improvements in the compass, or circumferenter, here patented, are two. The first consists in making the compass plate double, the plates of which it consists turning round upon each other. The circle of the compass is divided in the usual manner; the lower plate is also divided into degrees and parts of degrees, which are hidden excepting at one point, where an opening through the edge of the upper plate exposes them. In this opening there is a vernier, graduated so as to divide the divisions on the lower plate into any required part of a degree. The lower plate is capable of being rendered stationary by means of a screw; and when this is done, angles may be laid off by means of the sights, which may be moved round with the upper plate, without employing the needle for that purpose; thereby avoiding the uncertainty, or the difficulty, attending the process.

The second improvement consists in colouring the surface of the compass plate green, or bronzing it, instead of silvering it in the usual way, thereby relieving the eye from the unpleasant and injurious effects of the white plate. A narrow silvered rim surrounds the bronzed surface, giving a distinct view of the needle point.

Those who are aware of the excellence of the instruments made by Mr. Young, will be prepared to believe that what he denominates improvements are really such, and the result in the present instance will certainly justify the anticipation.

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17. For a *Universal Mill,* for grinding paints, drugs, dye stuffs, corn, rye, wheat, barley, oats, and various other substances; James Bogardus, city of New York, January 18.

In this mill, both the stones are made to revolve, but the upper one receives its motion from that of the lower, in a way to be presently described.

The lower stone is fixed firmly upon a vertical shaft which is made to revolve by the application of any suitable power, and with any required speed. The upper stone is made smaller than the lower, say one-fifth less in diameter, and it is placed so as not to be concentric with it; it may, for example, be so situated that the peripheries of the two stones will coincide on one side, whilst on the opposite side one-fifth of the diameter of the lower stone will be exposed.

The upper stone is kept in its place and its pressure regulated by means of a screw passing through a beam above it, the point of which bears upon a bridge piece in the middle of the eye. It will be at once evident that the revolution of the lower stone will give a slower and peculiar revolution to the upper. A hopper is to rise above the eye of the upper stone, and other requisite appendages are employed.

The claim is to "the manner of placing the upper stone off the centre of the shaft of the lower stone."

Metal, it is mentioned, may, in some cases, be employed instead of the stones for grinding.

18. For *Sliding Valves for Steam Engines;* Thomas Halloway, Northern Liberties, Philadelphia county, Pennsylvania, January 18.

Side pipes are cast on the cylinder as usual, but so arranged as to adapt them to the particular construction of the slide valves. At each end of the cylinder, over the side pipes, a flat plate is cast, which has three openings in it, arranged lengthwise of the cylinder. They are equi-distant from each other, and the space between them is to be a little greater than the width of the opening. The faces of these plates must be ground perfectly true. The sliding valves which cover them are cast in one piece, being connected together by a stem extending from one to the other. There is an excavation on each of the sliding faces, which embraces two of the openings, and the space between these, forming a steam way from one to the other. Of the three openings at each end of the cylinder, the middle one communicates with the boiler, the inner one with the cylinder, and the one nearest the ends are for escape steam. The excavation in the valve as it slides, covers alternately the centre and inner, and the centre and outer openings. Those acquainted with the action of the engine will at once understand the operation of this valve.

It will be seen that this, like most of the patents taken for steam engines, is a mere point of modification or arrangement; it is, however, more simple than some of the slide valves in use.

19. For a *Valve for the Vibratory Steam Engine;* Thomas Halloway, Northern Liberties, Philadelphia county, Pennsylvania, January 18.

(See specification.)

20. For a *Wing Gudgeon Valve for Steam Engines;* Thomas Halloway, Northern Liberties, Philadelphia county, Pennsylvania, January 18.

(See specification.)

21. For a *Machine for cleansing Paper Pulp*, called the "Piston Pulp Strainer;" James Sawyer, Newbury, Orange county, Vermont, January 21.

This pulp strainer differs entirely in its mode of action from that patented by Thomas L. Woodcock, p. 301, vol. vi. The pulp is put into a mixing tub, within which an agitator is kept in motion; attached to the mixing tub, is another, which the patentee calls the cellar, and between the two there is a part partitioned off, having a piston working up and down in it, which operates as a forcing pump. This piston is to make about fifty strokes in a minute; as it is raised it admits a portion of the pulp from the mixing tub into the chamber, and as it is depressed, it forces this pulp into the lower part of the second tub, or cellar. Near the upper part of the cellar there is a metallic strainer covering its whole surface, through which the pulp is forced, and from which it runs through a spout into the vat. For an ordinary cylinder machine this strainer may contain about two and a half square feet of surface.

The chamber and piston are so constructed that the latter in raising, during about one-fourth of the stroke, tends to exhaust the cellar, and this draws a portion of the pulp back through the strainer, serving thus to free it from the knots and coarse stuff which would otherwise obstruct it.

The claim is "to the principle of cleaning paper stuff, or pulp, in the way and manner above described; that is, the application of a vacuum formed within or under the sieve or strainer, thereby causing a reaction of water back through the apertures of the sieve or strainer, about one-fourth part of the time, which serves to admit the stuff, or pulp, to flow freely through."

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22. For an improvement in *Cards for Carding Machines;* Edward Faber, Pittsburgh, Allegheny county, Pennsylvania, January 24.

A thin piece of sheet lead, or other metal, is to be laid on one or both sides of the card leather, which is then to be pritched for setting the teeth. The metal, or other material used, may be attached to the leather by glue, cement, or otherwise.

The object of doing this is to render the teeth more stable than when set into leather alone.

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23. For a combined *Clover, Corn Shelling, and Thrashing Machine, with a Grist Mill;* Daniel Mullier, Wooster, Wayne county, Ohio, January 24.

Each of these machines has its separate architypes in the patent office, and elsewhere. The clover machine is a cylinder rubbing against a concave bed; the shelling and the thrashing machines are also cylinders with suitable beaters and teeth, with corresponding concaves; the grist mill consists of iron disks, one foot in diameter, placed vertically, and the whole are fixed on one frame, and driven by bands and whirls. The claim made is to the combination of the several machines named.

With regard to the separate machines, we apprehend that they are all of sufficient age to have entered into public life, and their fathers are probably long since dead. What exclusive right the mere placing them upon the same frame can give to the patentee, we cannot perceive; to us it appears something like a patent for putting each of them into the same barn. New machines, it is true, are generally but new combinations of parts, or instruments, before known: levers, wheels, pinions, axles, cams, weights, and springs, have been long known and used; but they are still capable of new combinations, producing new machines, with new results; and it is this kind of combination of old things which constitutes the subject matter of a patent. Should I make a machine like that described, but leave out the least valuable part of it, the grist mill, would the patentee still claim it as his combination? we trow not, as this would include the claiming of all the individual machines of which his combined machine is compôsed.

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24. For a *Machine for making Wrought Nails;* James W. Harvey, Jamestown, Chautauqua county, New York, January 24.

The nail rods are to be heated and passed down perpendicularly through a tube, or guide, between two swedging wheels, or rollers, which have indentations on them to form the edges and heads of the nails, and furnished also with chisels which cut them off of proper lengths. These rollers are made of steel, are ten inches in diameter, and of such thickness as the size of the nail may render necessary. On their lower sides they dip into boxes containing water, to preserve them from being too highly heated. The sides of the nails are to be formed by two other iron rollers, or wheels, which revolve at right angles with the swedging rollers. These are to be four feet in diameter, and are to approach each other sufficiently near to determine the thickness of the nail. All these rollers revolve in a vertical position. We shall not now attempt to describe the accessory apparatus for giving motion to the respective parts, as we deem this unnecessary. The claim is to the large rollers or wheels, for forming the sides of the nails; the swedging rollers, or die plates, not being considered as new.

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25. For an improvement in the mode of *Manufacturing Buck Shot;* John Snyder, city of New York, January 26.

A mould is to be made very similar to those heretofore employed for casting buck shot, or bullets in rows. In the one described, two rows are to be cast at once, there being three bars of brass hinged together at one end. The hemispherical excavations for receiving the lead are made close to the upper edge of the mould, so that the shot may be cast without any neck to it, the opening forming the apex of the shot, as it stands when cast. On the sides, and at one end of the mould, ledges rise to prevent the running off of the lead in casting. The mould being closed it is to be held with its handle end a little elevated, the lead poured on, and allowed to run down towards the hinged end, filling the cavities in its passage: before the metal has set, the lead is to be scraped off the top of the mould with a chisel, leaving the shot separate, and ready to be delivered from it. It is to this last feature that the claim is confined.

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26. For an improvement in the *Self-sharpening Plough;* Bancroft Woodcock, Mount Pleasant, Westmoreland county, Pennsylvania, January 26.

(See specification.)

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27. For a composition of matter to be used in the *Manufac-*

ture of Spruce Beer; George Jones, Boston, Massachusetts, January 27.

From the twigs, boughs, and leaves, of the double white spruce, a material is to be extracted, without boiling or distillation, which the patentee calls "the superior improved oil of spruce, for the making of spruce beer." To form it, two pounds of the leaves, &c. are to be bruised, and soaked for three or four days in alcohol, *of a very high proof.* To every gallon of this, when filtered, three pounds of the essential oil of spruce are to be added: this is the composition for which the patent is taken.

The superiority of this composition over all others, its various uses and great virtues, are enumerated and insisted upon with considerable amplification. To make beer, one ounce of the composition, and one gallon of molasses are to be well mixed together, and two gallons of boiling water are then added; a half barrel is to be used to contain the mixture, and is to be filled up with cold water, when its contents are allowed to ferment.

The process of soaking the boughs, twigs, and leaves in alcohol, and then mixing the infusion with oil of spruce, are the things claimed.

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28. For an improvement in the *Grist Mill;* Gideon Hutchkin, Windsor, Broome county, New York, January 27.

The object aimed at by the patentee, he informs us, is to grind rapidly with small stones without heating the flour; and consequently to lessen the expense of erecting, and the power required for driving such a mill.

A quadrangular frame is to be made in the usual way; on the lower end of the spindle there is to be a projecting rim, or flanch, just above its step, or point; a clutch box, catching above this projection, prevents the spindle from rising. The upper stone is to be the runner, which rests, by means of a balance rine, upon the upper end of the spindle; this being formed hemispherical, and the rine hollowed to suit it. Above the balance rine is a collet and nut, which secure the stone from rising.

The balance rine and driver are to be so formed as to blow wind into the eye of the stone, by their revolution, and channels, or tubes, are to be made to cause currents of air to pass between the stones. By loading the bridge tree, the stone may be forced down, or the top of the spindle may be weighted for the same purpose.

The claims are to increasing the gravity of the runner in either of the ways above named; the inserting wings, or flights; the form given to the driver and balance rine, and the pipes, or channels, for passing currents of air, &c. &c.

The particular forms of some of the parts described in the specification, are no doubt new; in other points, however, the present patentee has trenched upon preoccupied ground. The flanch, or button, at the lower end of the spindle, was particularly described in a patent noticed by us sometime since. Stones also have been loaded at top, both by direct weights and by levers; and air holes have been made for the purpose of cooling the flour. The claim, therefore, if good, must rest upon the precise manner adopted by the patentee.

29. For a *Machine for Washing Hats;* Samuel Drinkhouse, Easton, Northampton county, Pennsylvania, January 30.

A wheel six feet in diameter is to be hung by its axle over a trough containing water. Upon each side of the rim of the wheel there are to be pins upon which to place hats, and catches to secure them. A dozen may be placed on each side of such a wheel, and on turning a crank they will be rapidly washed. The whole machine is considered as new, no claim being made.

30. For a *Piston Safety Valve* for steam engine boilers; John C. Douglass, city of New York, January 30.

The contrivance here proposed is to raise the ordinary safety valve when the steam arrives at a certain pressure, although, from expansion, or any other cause, it may adhere to its seat. The lever of the safety valve is to extend out beyond its prop, or support, on the side opposite to the arm carrying the weight valve, converting it, in this case, into a lever of the first kind: if the extreme end be depressed, the valve, therefore, will be raised. Near this end of the lever, a small cylinder, with a piston working in it, is inserted into the top of the boiler. The piston rod is held down with the required force by a spring steelyard, or by any other measured weight. From the top of the piston rod, a rope, or chain, descends, passes under a pulley, and up to the end of the lever, to which it is attached. When the force of the steam suffices to raise the piston, the end of the lever is, consequently, drawn down, and the opposite end, carrying the safety valve, is raised.

It is much to be doubted whether such an apparatus would generally accomplish the end proposed. The force by which the piston is held down must in but a small degree, exceed that at which the safety valve ought to rise, as it must act as soon as the valve itself ought to operate. When a valve adheres, as it sometimes does, with very great force, the extra elasticity which will enable the patented apparatus to overcome this adhesion, is replete with danger to the boiler, upon the whole interior of which its power is operating. It is to be borne in mind also, that although explosions do no doubt sometimes take place from the adhesion of the safety valve, this is not the only, nor indeed the most frequent, cause. Admitting, therefore, that the apparatus in question would always answer the purpose of its construction, it still must not be depended upon as affording any thing like perfect security. There is another circumstance which will militate against this apparatus, and which is inherent in the use of a steam-tight piston. The amount of friction to which it is subjected in its cylinder is perpetually varying, and the force necessary to raise it will consequently differ at different times; upon the whole, therefore, we are led to the conclusion that this contrivance will not effect the object for which it was made.

31. For an improvement in the *Truss for Vessels;* Jonathan T. Quimby, Belfast, Waldo county, Maine, January 30.

So far as we are judges of nautical affairs, this truss appears to present advantages over those of the common construction. We cannot describe it without a cut, but the claim will show the nature of the improvements which the inventor believes that he has made. The hoop which encircles the mast is connected to the yard hoop by means of what is called a truss-bow, attached to wings or ears on the former. The yard hoop swivels on this bow by means of a socket joint. The claim is to the truss-bow, which is so constructed that it will not, in any position of the yard, interfere with the launching, sending up, or housing, of the top-mast. "The connexion of the hinge and swivel joints, which, as constructed, brings the centre of motion within two inches of the yard, so that when the yard is braced sharp to the wind it is not carried to the leeward any more than a distance equal to half its diameter, and consequently may be much more easily and quickly squared."

32. For a *Machine for Thrashing Rice and other Grain;* Orlando Hurd, Bridgeport, Fairfield county, Connecticut, January 31.

The cylinder and concave of this thrashing machine are to be covered with plates of cast iron, having spurs, or teeth, cast on them, to operate in the usual way. In its form and construction it is like the greater number of its elder brethren, some of which also have had teeth of cast iron. The patentee does not make claim to any thing new in it.

33. For an improved *Method of Generating power by High Steam;* Benjamin Phillips, city of Philadelphia, January 31.

Should it appear that the patentee of this improvement has really accomplished what he professes, his steam engine will be invaluable, as he informs us that he has invented a "method of generating power by high steam with perfect safety, and without danger of human or animal life, and without risk or possibility of explosion either of the boiler or generators." This he proposes to accomplish by a new and original plan of applying the fire; a new plan of constructing furnaces and generators, and other points of novelty.

The specification does not very distinctly explain the particular construction of some parts of the apparatus, nor do the references to the drawings supply the deficiency. There are in fact several figures in the drawings to which no reference whatever is made, and, although not entirely ignorant upon the subject of steam engines, we are not able to divine their use; these, therefore, we must pass over.

The cylinder is to have the usual shape, and the ordinary slide valves; and the improvement of this part consists in using strong cast, or wrought iron heads, "with spherical surfaces inwards;" meaning, we suppose, that they are to be convex inwards. Coal furnaces are to be used to heat these heads *red hot*, which furnaces may be removed at pleasure. This, we think, is a bad beginning where perfect safety is a main object. There are to be vessels, which the patentee calls *generators*, but which are rather a species of steam chest, as they do not generate steam, but receive it from a boiler. They are to be of the same size with the cylinder, in order that they may contain steam enough to fill it. There must be two of them to supply steam on each side of the piston alternately. The boiler is to be of the low pressure kind, the steam is to pass from it into the generators, which are also to be heated by a coal furnace. It appears, therefore, that low steam is to be generated in the boiler; and that from this it is to pass into the generators, which being highly heated by their appropriate furnaces, are to convert it into high steam; from the generators it is to pass into the *red hot headed* cylinder, where it gets higher still, and is to act upon the piston with great force, and then to escape.

What the piston is to be packed with, and whether its rod is to pass through the red hot heads, we cannot tell, as neither the description nor the drawings enlighten us upon this point.

Another, or, we suppose, a modification of the same engine, is next noticed, but our picture of it would be less distinct than that just given, we therefore decline even to sketch it.

The machine already described, contravenes all our notions respecting the nature of steam, and the correct mode of applying it. This perhaps arises from an obtunded understanding, as the patentee avers that he has "described the foregoing inventions, improvements and discoveries in a true and correct manner, and in as clear a manner, and in as few words as possible to include all the sense and meaning, exact construction, and operation of the machine."

We think unfavourably of heads convex inwards, made red hot, to bear the pressure of high steam; we think unfavourably of the attempt to convert common into high steam, by heated generators, and heated cylinder heads, where no water is present to give the steam greater density; and we think unfavourably of the perfect security of generators which have, or which require, safety valves; because we believe that wherever safety valves are used, the idea of danger is admitted, and that where they are needed, danger does really exist. In fine, the whole of this contrivance appears to us under an aspect so unfavourable, that we should occupy too much space by arraigning its parts individually, whilst we should afford but little satisfaction to any one; we therefore leave it to the test of time and experience, wishing, though not hoping, that all the fond anticipations of its projector may be realized.

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a patent for a Valve for the Vibratory Steam Engine. Granted to THOMAS HALLOWAY, *Northern Liberties, Philadelphia county, January* 18, 1832.

To all whom it may concern, be it known, that I, Thomas Halloway, have invented an improvement in the construction and arrangement of the valves of the vibratory steam engine, and that the following is a full and exact description of my said invention.

I intend, usually, to place the trunnions or gudgeons upon which the cylinder is to vibrate, at or near its centre; this, however, is not a point of importance, as my principle is equally applicable in all situations of the trunnions, or gudgeons. In one of the trunnions, or gudgeons, there are two openings made for the admission of steam into each end of the cylinder. In the box, pedestal, or bearing, of this gudgeon there are three openings, one of which is in the centre for the escape of steam, the other two are for the admission of steam into each end of the cylinder, respectively. These openings are so arranged that when the engine is at half stroke, they are all closed; and at or near the end of the stroke, one of the openings in the gudgeon is over one of those for the admission of steam, and the other over that for the discharge of steam. This arrangement will be distinctly seen by the aid of the drawings, and the references thereto, deposited in the patent office, and making a part of this specification.

To prevent the raising of the cylinder from its bearing by the pressure of the steam, and to keep the gudgeon in proper contact with the pedestal, I apply a spring on the upper part thereof, or cause a friction roller to press thereon, or make use of any other device which I may prefer.

Among other advantages of this arrangement is the dispensing altogether with packing, the facility of oiling, and the certainty of the valve always remaining steam tight.

What I claim as my invention is the manner and principle of arranging the valves, or the openings for the admission and the discharge of steam, as hereinbefore described.

THOMAS HALLOWAY.

A patent was granted to Elisha Bigelow, of Baltimore, on the 6th of November, 1826, for a similar mode of letting the steam on and off in the trunnions of a vibrating engine, and there are others in which the same method is adopted, varying slightly in the mode, but acting essentially on the same principle.

Specification of a patent for a Wing Gudgeon Valve for Steam Engines. Granted to THOMAS HALLOWAY, *Northern Liberties, Philadelphia county, Pennsylvania, January* 18, 1832.

To all whom it may concern, be it known, that I, Thomas Halloway have invented an improvement in the valves of steam engines, which I intend to apply to locomotive operation only, and which is called the "Wing Gudgeon Valve," and that the following is a full and exact description thereof. I intend that the cylinder, or cylinders, to which my valves are applied, shall vibrate, in general, vertically, but this is not a point of importance, its position being governed by circumstances.

The cylinder is to have one large gudgeon, close to which, above and below, is a face plate, or wing, with an opening leading to each end of the cylinder, longitudinally, which face is exactly in the shape of the segment of a circle, as is shown by a model and drawings, deposited in the patent office.

The piece constituting the valve seats is cast about the width of the boiler, with a plate on each side corresponding with the face on the cylinder, and may be circular, or straight, according to the form of the top of the boiler. This valve seat has two distinct openings leading from a double division cock in the centre to the valve seats which the cylinder vibrates against, and passes out in two openings on each side, corresponding to the openings on the plate of the cylinder; and with the vibration of the cylinder it alternately receives and discharges steam.

It will be understood by every competent engineer that both the face of the plate valve seat, and that of the plate on the cylinder, are to be turned perfectly true, and made steam tight, and will be kept up by a spring, friction roller, or weight.

The cock, which has been mentioned, in the centre of this valve seat, and on the centre of the boilers, is to be so constructed that by turning half round, it reverses the power of the engine; that is, it makes the steam side the exhaust side, and vice versa; and it also answers to shut the steam from both engines: [qu. ends.]

What I claim as my invention is the arrangement of the cylinders and valves to a locomotive engine; the mode of fitting the valves; the construction of the cock in the centre to determine the direction of the engine forward or backward; and the simplicity of the whole, not having half the number of pieces when completed that the generality of English engines have.

THOMAS HALLOWAY.

Fig. 1, is the face of that half of the valve which is cast on the cylinder, with openings leading through the steam ways to the two ends of the cylinder.

Fig. 2. A circular plate forming the other half of the valve, faced to fit steam-tight on fig. 1. A, is an opening in it, to receive the trunnion or gudgeon B, fig. 1.

Fig. 3. A side view of fig. 2. C, the edge of the plate. D, a double tube connected with the boiler; the cock E changing either of the tubes into a supply or discharge tube.

Fig. 1.

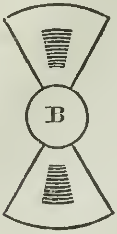


Fig. 2.

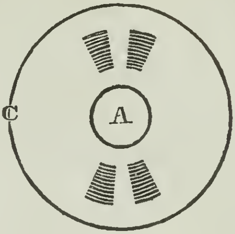
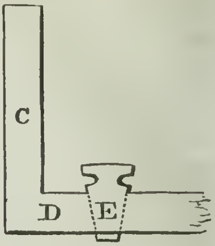


Fig. 3.



Specification of a patent for an improvement in the Self-sharpening Plough. Granted to BANCROFT WOODCOCK, *Mount Pleasant, Westmoreland county, Pennsylvania, January* 26, 1832.

To all whom it may concern, be it known, that I, Bancroft Woodcock, have invented certain improvements in the self-sharpening plough, and that the following is a full and exact description thereof.

In the self-sharpening plough, as heretofore made, the front part of the land side is cast in one piece with the mould board, and as the bottom edge of the land side wears, the part forming the groove into which the coulter slides gives way, and cannot be renewed without renewing the whole casting.

To obviate this objection, I cast the land side separately from the mould board, either in one or two pieces, as may be preferred. When made in two pieces they have a lap joint at or near the middle, which may be secured by a bolt and nut. Suitable holes to receive bolts and nuts, to attach the land side and mould board together, are also provided.

In forming the pattern for the mould board, I make its top to terminate in a standard, or sheath, extending up to the beam, and attach it thereto by a bolt and nut, or otherwise, and in forming the pattern of the land side, the front end of it is made with an arm or piece extending up so as to form a coulter.

For ploughing in rough or stony land I dispense with the coulter as ordinarily made, and substitute therefor what I call a pointed shank, passing it into the groove, and securing it in the same way with the coulter. When I use this, an erect coulter stands in front of it, the upper end of which is secured to the beam in any of the known ways. A hole or depression is made in the heel of the erect coulter, and into this the point of the shank passes, which serves to support and keep it steady. The respective parts herein named will be better understood by reference to the drawing deposited in the patent office.

What I claim as my specific improvement, and for which I ask a patent, is, first, the casting of the land side separately from the mould board, either in one or two pieces, as hereinbefore set forth; and I likewise claim the shank as described, to be used in lieu of the ordinary coulter, with its point entering the heel of the erect coulter in the manner and for the purposes specified.

BANCROFT WOODCOCK.

ENGLISH PATENTS.

Specification of a patent granted to ANGIER MARCH PERKINS, *county of Middlesex, Civil Engineer, for certain improvements in the apparatus or method of heating the air in buildings, heating and evaporating fluids, and heating metals. Dated July* 30, 1831.

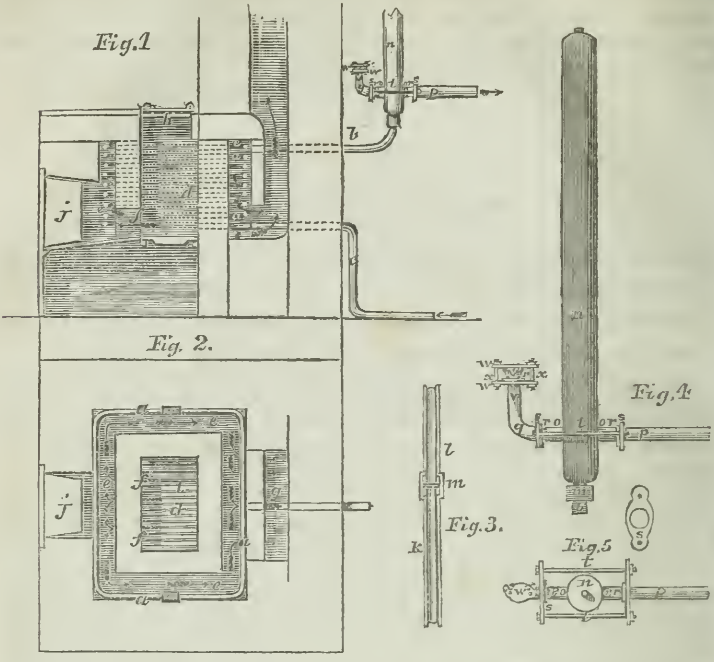
To all to whom these presents shall come, &c. &c. *Now know ye*, that in compliance with the said proviso, I, the said Angier March Perkins, do hereby declare the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained in and by the following description thereof, reference being had to the drawings hereunto annexed, and to the figures and letters marked thereon, (that is to say:)

My invention relates to that description of apparatus or method of heating which is now largely employed in heating buildings, and for other purposes, by the circulation of hot water; and the object of my improvements thereon is to obtain considerably higher degrees of temperature to the water circulated, and thus I am enabled to apply my apparatus to a variety of purposes which require the heating medium to be at a higher degree of temperature than that of boiling water. And my improvement consists in circulating water in tubes or pipes which are closed in all parts, allowing a sufficient space for the expansion of the water which is contained within the apparatus, by which means the water will at all times be kept in contact with the metal, however high the degree of heat such apparatus may be submitted to, and yet at the same time there will be no danger of bursting the apparatus, in consequence of the water having sufficient space to expand.

But in order that my invention may be fully understood and carried into effect, I will now describe the drawings hereunto annexed, which represent the improvements applied in various ways.

Description of the Drawing.

Fig. 1 shows the section of the description of furnace I prefer; and fig. 2 is a plan also in section: in each of these figures the same letters of reference indicate similar parts; and such is the case in the other figures in the drawings. The description of tubes which I have used and find to answer, are what are called drawn gas tubing; and the size I most commonly employ is about one inch outside diameter, and the diameter of the inner area is about five-eighths of an inch; but I do not confine myself to the use of this size tubing.



In figs. 1 and 2, *a a a* is a coil of tubing, which is placed within the furnace, as shown in the drawing; *b* is a tube by which the water passes from the coil *a*, when in a heated state, and *c* is the tube by which the water is returned to the coil after having given off the heat, to effect the object to which the apparatus is applied, whether for heating the air in buildings, evaporating fluids, or heating metal, as will be more fully described hereafter.

The furnace consists of two compartments *d* and *e;* the compartment *d* is that in which the fuel is burned, and the compartment *e* surrounds that at *d*, and is a sort of hot chamber, into which the coil of tubes *a* is placed, and the water therein becomes heated by the heat which is generated in the compartment *d*, the smoke and heated air passing from the ignited fuel at *f*, into the compartment *e*, and thence into the chimney *g*.

The description of fuel which I prefer is coke, or stone or other coal, as free from bituminous matter as possible, which is put into the compartment *d*, at the upper part at *h*, over which there is placed at all times a cover, to prevent any draft passing in that direction, by which means, when the fire is lighted, and the fuel is filled up to the top of the compartment *d*, and the opening at *h* covered, the air which produces the combustion will pass up through the fire bars at *i*, and the fuel on such bars will in a short time become an ignited mass: *j* is an opening or door in the front of the furnace, by which the same may be stoked, or the fire lighted.

Figs. 3, 4, and 5, show the manner in which I construct the joints of the apparatus, which are shown on a larger scale for the purpose of making them more clear. Fig. 3 shows in section the manner of connecting two tubes, *k* and *l*; it will be seen that the end of the tube *k* is tapered off both inside and out to a sharp edge, which buts against the straight surface of the end of the tube *l*. On the ends of these tubes are cut screws, the one having a right hand screw, the other a left hand screw, and by means of the coupling piece *m*, which has a female screw cut right and left, the two ends of the tubes *k* and *l* are brought together, and by this means a strong water-tight joint is made, and in this manner I connect any number of tubes together, according to the purpose to which the apparatus is to be applied.

Figs. 4 and 5 are two views of the connexions of other parts of the apparatus, and also of the part of the apparatus which is intended for the expansion of the water; *n* is an upright tube, closed at the top, having a small screw hole to let out the air when the apparatus is filled with water, but which is kept perfectly closed when the air is driven out. This tube *n* is usually made of a larger size than those in which the circulation takes place, and in this tube there should be an area equal to the quantity of expansion which will take place in the water contained in the outer tubes, and as water expands about one-twentieth without being converted into steam, I leave at least double that quantity of capacity in the tube or vessel *n*. *o o* are two short tubes formed into cones at their two ends: these cones enter into holes perforated in the tube *n*, and into the ends of the tubes *p* and *q*, the tube *p* being the one by which the hot water is conveyed from the coil *a a*, after it has become heated, and the tube or pipe *q* is the point at which the apparatus is filled with water, and by which the height of the water is regulated; and this tube *q* is to be placed in such a position that there shall be sufficient space above it in the tube *n*, to allow for expansion.

On the tubes *p* and *q* are two collars *r* formed, and by means of the two plates *s s*, and the screw bolts and nuts *t t*, there will be a strong water-tight joint formed to all the parts. At the top *v* of the pipe, there is a collar *r* formed, and by the plates *w*, and screws and nuts *x*, the cone *y* is strongly held in the opening of the tube *q*, by which the same is made water-tight when the apparatus has been filled with water. To the bottom of the expansion tube *n* is connected the pipe *b*, by similar coupling as that described in fig. 3.

Having now described the manner in which I conceive it best to construct the various parts of the apparatus, I will now proceed to describe some applications of the same. Fig. 6 shows a longitudinal view, and fig. 7 shows a plan of an arrangement for applying my improvements to hot plates which are intended to be used by copperplate and other printers, for the purpose of heating the plates from which impressions are to be taken. I have not thought it necessary to show the presses, or any other parts of the machinery used for printing. The plates A A being intended to be used in place of the charcoal fire grates heretofore employed for heating the plates at the time the ink is being rubbed in. One of these heated plates, A, is placed in the proper position at each press, if more than one is to be heated, and it will be evident that a large number of presses may have their plates A, heated by one set of tubes. The tube *p* is the one which, as above described, conveys the heated water from the furnace, and the tube *c* returns it back to the coil after it has given off its heat.

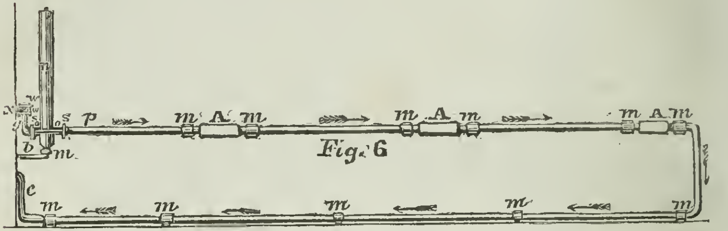


Fig. 6

Fig. 7

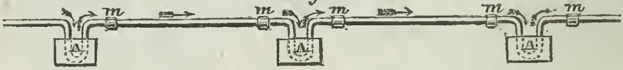
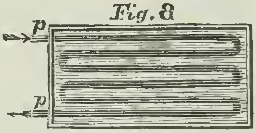


Fig. 8



The manner in which I construct the plates A, is as follows: I make a rectangular mould of the size required, and place therein the bent part of the tube *p*, and then fill the mould with melted lead, or other metal, according to the degrees of heat such plates are intended to bear, by which means I produce metal surfaces, which become heated by the passage of the heated water through the tubes *p*; and it is evident that such heated plates may be applied in a variety of ways, and for a variety of purposes, such for instance as hot plates for cooking purposes.

Fig. 8 shows the manner of applying the apparatus to a rectangular boiler, and which boiler is shown in plan, and is applicable to the boiling of sirop in the making or refining of sugar; by which it will be seen that the heated water is made to circulate through a series of tubes, and give off its heat to the fluid contained in the boiler, or these tubes may be made to pass into steam, or other boilers, in a similar manner, and will cause the fluid contained in such boilers to become heated and evaporated.

In heating the air of rooms of buildings, the tubes *p* and *c* may be made to pass around the flooring of such room, and where a large quantity of heat is desired, it will sometimes be desirable to have more than one pipe passing to and from the coil of pipes contained in the furnace, whereby a larger quantity of heated surface will be presented, which being heated to a high degree of temperature, will give off the same to the air contained in the room or buildings, and warm the same; and I have found that when the circulating tubes present a surface equal to three times that of the coil of tubes in the furnace, I have not been able to burst the tubes.

Having now described the nature of my invention, and the manner of carrying the same into effect, I would have it understood that I lay no claim to the various parts of which such apparatus is composed. Neither do I claim the application of the circulation of hot water to the purposes above described; but what I claim as my improvements in such apparatus or method of heating the air in buildings, heating and evaporating fluids, and heating metal, consist in circulating water in tubes or pipes, which are closed in all parts, and having sufficient space allowed for the expansion of the water as above described.

In witness whereof, &c. [*Rep. Pat. Inv.*

¶ *Experiments on the Strength of different kinds of Wood, made in the Carriage Department, Royal Arsenal, Woolwich. By Peter Barlow, Jr. As. Inst. Eng.*

The following series of experiments, several of which I attended, being made on species of woods the strength of which has not been previously ascertained, will, I trust, not be considered uninteresting to the readers of the Philosophical Magazine and Annals, particularly as the results are not only curious, but may probably lead to useful and important investigations as connected with the introduction into, and the growth of foreign timber in, this country, as well as to important improvements in the present system of planting. Under this impression I have been induced to send them to you as an addition to the several others on the same subject which have appeared at different times in this Journal. The experiments originated in an investigation of the comparative properties of acacia and oak by W. Withers, Esq. of Norfolk, whose object appears to have been to encourage the planting of the former in many situations instead of the latter, as a wood of great durability, and of quicker growth.

In order to have a comparison made of their relative strength he forwarded specimens of both woods to Woolwich, and the results of the experiments will be seen in the following table. Another question arose with Mr. Withers relative to the strength of oak, the growth of which had been encouraged by culture, compared with oak of the ordinary slow growth.* The specimens connected with the latter subject, the author informs us, were received from Mr. W.

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* See a letter to Sir Henry Stewart, Bart. on the improvement in the quality of timber, by W. Withers, Esq.

Boorne, of Erpingham, the one from a fast, and the other from a slow, growing tree. They are marked Nos. 3 and 4 in the table of experiments. The former was grown on a very good strong soil, its age was supposed to be about sixty years, and it contained from thirty-eight to forty cubic feet of timber: the other, No. 4, was about 120 years old, and was grown upon light soil, with gravel about two feet below the surface. This tree contained about eighty cubic feet, but Mr. Boorne considers that if No. 3 had stood to attain the same age, it would have made at least forty feet more than that tree. The other two specimens were from trees furnished by Mr. Samuel Farrow, of Diss, Norfolk, grown on the same piece of land: that from which No. 5 was cut stood near the rack yard of the farm by the side of a ditch, into which ran a great deal of moisture from the yard; and he has no doubt that, independently of the nourishment obtained by it from the ditch, very many of the smaller roots reached as far as the rack-yard: the tree grew rapidly, and contained when cut down 120 feet of timber. The tree from which No. 6 was cut, grew, as before stated, in the same field, but had none of the advantages above spoken of, but still the soil was good with a lightish blue clay bottom. The tree grew well, but not in any degree so fast as the other; it contained about ninety feet of timber, and it is the opinion of persons on the spot that they were both planted together.

Thus far the experiments were made with a particular object; but as there were in store in the Royal Arsenal, many woods not in very common use, but which are grown abundantly in some countries, and from the appearance of which great strength was anticipated, Mr. Bossey, foreman in the carriage department, was requested to prepare specimens, which were submitted to the same test as the former ones.

These results are interesting, some of the woods being more than double the average strength of oak: several of these specimens were sent from Berbice, by Capt. Gipps, of the royal engineers, who speaks very highly of their durability.

The apparatus made use of in the experiments consisted simply of two upright posts, fixed securely at one end in the ground, and at the other to the tie beam of the roof of a shed; on each of these were firmly attached two pieces of hard wood formed to an edge, on which the specimens to be experimented upon were placed, and a scale suspended from the centre to receive weights. To ascertain the relative stiffness or elasticity, the weight which caused a deflection of one inch, was registered. The deflection was denoted by a rod attached to the tie beam, so as to point downwards in front of the middle of the specimen, and one inch below the upper surface; so that when one inch of deflection had taken place, it was shown by the rod just passing clear of the piece under experiment.

In the table, the first column contains the names of the woods; the second the specific gravity; the third the weight which caused one inch deflection, or one-fiftieth part of the length; the fourth the breaking weight; the fifth the relative elasticity from the formula $E = \frac{l^3 w}{a d^3 \delta}$; the sixth the strength from the formula $S = \frac{l w}{4 a d^2}$; where l is the length, a the breadth, d the depth, δ the deflection in inches, and w the weight in pounds, by which they become comparable with the various experiments in Barlow's Essay on the strength of timber; and the last column contains any requisite description or remarks.

The pieces were each accurately cut and planed two inches square and five feet in length, and the distance of the props on which they were broken was exactly fifty inches; they were selected with great care by Mr. Bossey, who assisted at the experiments, and registered and delivered the following results.

Table of the Strength and Elasticity of various Woods, of English and Foreign Growth.

No. of Exper't.	Names of Wood.	Specific gravity.	Wt. in lbs. which produced 1 inch deflection.	Breaking weight in lbs.	Value of E from the formula E $=\frac{l^3 w}{4ad^3\delta}$	Value of S from the formula S $=\frac{lw}{4ad^2}$	Remarks.
1	Acacia, Eng. growth.	710		1195		1867	
2	———, Do.	710	bore	1084	rope broke	the piece	little injured.
3	Oak, fast grown.	903	660	999	5156250	1561	Specimens supplied by W. Withers, Esq.
4	——, slow grown.	856	414	677	3234375	1058	
5	——, fast grown.	972	550	999	4296875	1561	
6	——, slow grown.	835	439	943	3437500	1473	
7	——, superior quality.	748	896	1447	7000000	2261	Fine specimen.
8	——, Do.	756	680	1304	5312500	2037	In store 16 yrs.
9	Tonquin Bean, middle.	1036	1388	2414	10843750	3850	This timber was sent from Berbice by Captain Gipps, R. E.
10	Tonquin Bean, outside.	1080	1332	2228	10406250	3481	
11	Locust, middle.	972	1052	2116	8007812	3303	
12	Locust, outside.	936	940	2284	7343750	3568	
13	Bullet tree, middle.	1029	1360	1724	10625000	2696	
14	Bullet tree, outside.	1029	1332	1668	10406250	2606	
15	Green heart, middle.	1015	1332	1892	10406250	2956	
16	Green heart, outside.	986	1388	1612	10843750	2562	
17	Cabacally, middle.	907	952	1668	7437500	2606	
18	Cabacally, outside.	892	940	1556	7343750	2431	
19	African oak, middle.	972	1168	1447	9132812	2261	From a very fine timber long in store.
20	African oak, outside.	972	1168	1643	9125000	2589	
21	African oak, middle.	1015	1288	1643	10062500	2567	
22	African oak, outside.	972	1097	1643	8570312	2567	
23	American black birch, middle.	648	775	1279	6054687	1967	A long time in store, very dry; the same tree.
24	American black birch, outside.	633	775	915	6054687	1430	
25	American black birch, middle.	648	644	1027	5031250	1604	
26	American black birch, outside.	669	831	1433	6492187	2239	
27	Common birch, middle.	792	800	1164	6250000	1820	
28	Common birch, outside.	630	884	1304	6908250	2037	
29	Ash, middle.	727	660	1304	5156250	2037	Dry, and of same plank.
30	Ash, outside.	702	660	1304	5156250	2037	
31	Elm, middle.	554	436	772	3406250	1206	Dry, and of same tree.
32	Elm, outside.	532	324	660	2531250	1031	
33	Christiana deal, middle.	698	856	1052	6687500	1644	Dry, and of same deal.
34	Christiana deal, outside.	680	772	940	6031250	1480	
35	Memel deal, middle.	590	786	1108	6140625	1731	Dry, and of same deal.
36	Memel deal, outside.	590	856	1108	6687500	1731	

It is to be regretted that the results of the acacia were not more particularly noticed; but not having in view at that time to carry on so extensive a course of experiments, means were not taken to ascertain its stiffness. The second specimen, after the rope broke, was found but little injured by the experiment, which certainly indicates considerable power of elasticity, although the exact amount was not numerically ascertained. This specimen was preserved unbroken. Upon the whole, however, it has the advantage of the oaks in strength, except those marked No. 7 and 8, which were remarkably fine specimens; but it will be found by referring to Barlow's Essay greatly to exceed the strength of the oak in general.

The results of the oak experiments seem certainly to be in favour of the fast grown. "These experiments," Mr. Withers observes, "throw new light upon the subject, and lead to the most important conclusions. They prove not only that fast growing timber is superior in quality to that of slower growth, but by the constant application of manure to the roots of trees, planted even in good soil, nearly double the quantity of timber may be obtained in the same period, while its strength, instead of being diminished, will be thereby increased."

[*Phil. Mag. and Annals of Philos., No.* 63, *March*, 1832.

¶ *Observations on Mr. Barlow's experiments on the Strength of different kinds of Wood. By B. Bevan, Esq.*

To the Editors of the Philosophical Magazine and Annals.

Gentlemen,—I have perused the valuable communication of Mr. Barlow, in your last number, on the strength and elasticity of several species of wood, and join in regret with Mr. Barlow that the experiments on acacia were not complete.

Some time since an opinion was held by some carpenters in Northamptonshire in favour of the superior strength and durability of acacia, and a prime specimen was sent to me for trial. I found it inferior to good oak in strength, and something inferior in elasticity; but as to durability, I am not aware of any proper test; but from the texture and appearance on fracture I should esteem it very inferior.

From my experiments on that species of wood, I can supply the omission in the fourth column of Mr. Barlow's table. The modulus of elasticity of acacia, by my experiments, being 4,560,000 feet, from which it will be easy to deduce the deflection of any scantling under a given pressure, and for the particular case of Mr. Barlow, where $l = 50$ $b = d = 2$, and $\delta = 1$, and specific gravity .710, we have $\frac{.710 \times 4{,}560{,}000}{4{,}500} = 720$ nearly for the weight required to produce a deflection of one inch.

It will be observed by persons accustomed to experiments of this nature, that the deflection of one inch approaches too near the ultimate flexure to give a fair measure of the elastic force of the specimen; the average of Mr. Barlow's experiments being nearly two-thirds of the ultimate strain, instead of one-third, which would have been less likely to have impaired the texture of the specimen.

In experiments of this nature it would have been more satisfactory if Mr. Barlow had said something about the *time* during which the specimen was under pressure; as the deflection increases with the time, especially when the load bears so great a proportion to the breaking weight.

Instead of the proportional numbers adopted by Mr. Barlow to express the elasticity, I beg leave to suggest that it would have been more generally useful if the *modulus of elasticity*, had been given. To enable your readers to compare the relative stiffness of the several species of wood in his experiments, I hereby send you the approximate result as deduced by a very simple application of the slide-rule. Thus,

a	4500	Feet modulus of elasticity.
b	specific gravity.	Weight in lbs.

From which it will be found that the mean modulus of the several species of wood in the table of Mr. Barlow will be nearly as follows:

	Feet.		Feet.
Oak	3.303000	American birch	5.295000
Tonquin bean	5.795000	Common birch	5.420000
Locust	4.695000	Ash	4.150000
Bullet	5.890000	Elm	3.135000
Green heart	6.105000	Christiana deal	5.305000
Cabacally	4.730000	Memel deal	6.260000
African oak,	5.532000		

Hence it appears that when compared with their own weight, (although probably the specimens were superior to the ordinary quality,) none of those tried by Mr. Barlow possess a greater degree of stiffness than Memel deal.

It would have added much to the value of the above experiments if Mr. Barlow had given the ultimate deflection. If he has the means of giving this information, it will add to the gratification of many of your readers, and to none more than to your humble servant,

B. Bevan.

P. S. If the price per foot at which the new species of wood above named can be procured, could be communicated, it would be an additional favour.

[*Phil. Mag. and Annals of Philos.*, *April* 1832.

Experiments with the Diving-Bell.—By Thomas Steel, Esq. M. A. Magdalen College, Cambridge.

In 1826 we gave an account of a communicating diving-bell, invented by our esteemed friend and correspondent, Mr. Steele. It consists, as some of our readers may recollect, of two compartments in combination; one of them, the common diving-bell, open at the bottom, the other a close chamber, with a bottom, called by the inventor, "the communicating chamber." The latter is supplied with air by pipes reaching above water, and is separated from the former by a partition, in which is set a small circular window of great thickness and strength, but so transparent as to admit of a person in one chamber seeing distinctly through into the other. Mr. Steele has recently projected some important improvements in this apparatus, a full description of which, from his own pen, we hope in a week or two to be able to lay before the public. With the view in the meanwhile, of preparing the reader to appreciate duly the value of these improvements, we now propose to give, in a somewhat abridged form, an account of the diving-bell experiments which have given Mr. Steele a practical knowledge of those difficulties which it has been his study to obviate, and which, if we are not greatly mistaken, he has obviated successfully. We extract it from the Appendix to Mr. Steele's "Practical Suggestions on the General Improvement of the navigation of the Shannon."

Narrative of circumstances which led to the invention of the communicating Diving-Bell.

Some years ago, I saw, lying near the harbour at Portsmouth, the diving bell which had been made use of by the late Mr. Thompson, when he descended upon the Royal George, sunk at Spithead; he called it his bell of observation, and it was calculated for no other purpose, as it was a close vessel. It was about six and a half or seven feet high, and of a form very like a grape jar. There was a water-tight circular cover that screwed into the top, and there were five small circular eyes, (little windows of strong glass,) of about four inches in diameter, in the circumference of the part where it swelled; and across each of these there was a small bar on the outside, to prevent fracture by impinging while under water upon any hard substance. There were two flexible tubes inserted into the cover by water-tight screws, and through these the engineer, when he descended, was supplied with air, and also held conversation with the persons above water. My curiosity was excited, and I went to Gosport to find out the person, who I was informed had been in the habit of attending upon deck when the bell was under water, to receive orders from below, and have them carried into execution. He afforded me a great deal of very interesting information, and particularly gave me assurance of the distinctness with which the voice could be heard from under water, and conversation carried on through the tube, which was called the trumpet; the second tube was called the air pipe. The man's name who gave me this information is Wood, and I believe he now works at a shipwright's at Fareham.

In the year 1825 I made, for the first time, as a matter of curiosity, a descent in a common working bell, of course open at the bottom. While I was under water, I was more occupied in making observations on what I saw than in deducing consequences; but after ascending, it suddenly occurred to me, that I could make a great improvement in diving-bells, by combining with the common working bell the bell of observation; for "suppose there was a little window in the bell in which I was down, what would there be to prevent Thompson from looking into it from his bell and telling what he saw?"

Let me, therefore, suppose the two bells to approximate until they coalesce, and have a common side and common window; the engineer in the bell of observation, sitting without pressure from condensed air, and quite at ease, no matter at what depth the bell may be working, will look into a little submarine illuminated chamber, (the bell in which I descended had been illuminated by a lantern;) will see every thing that is doing, and hold conversation with the persons above water.

Thinking one evening afterwards of the violent strain on the chain of suspension, and the consequent danger, when the bell emerging, ceases to have any support from the water, I set myself to work, to find out some method of getting the men out unwet, without the necessity of raising the bell itself out of the water.

A mode of doing this, theoretically possible, quickly suggested itself to me; but one which, in practice, would call to memory the story in Peregrine Pickle, of the gentleman who was remarkable for great mechanical inspiration, and had invented a beautiful machine for cutting cabbages; to the general use of which, however, there was a practical objection, by no means unimportant, namely, that it required the aid of a man and a horse to work it in the cabbage bed.

This theoretical non-impossibility, was as follows: Suppose the bell, (I mean the common working bell,) to be brought to rest upon a ledge, or little platform, projecting horizontally under water from the side of the ship; suppose a tube of a diameter of something less than a yard, bent at an angle, and one leg so much longer than the other, that while the extremity of the shorter leg was placed under, and in contact with the platform, the extremity of the longer one should be above water. Now, imagine the shorter leg to be not merely in contact with, but united to the platform. Let us now suppose a circular hole in the platform over the tube, with an air-tight cover; and let us suppose the longer leg to terminate above water, in an air-tight chamber, with an air-tight door. Now it is quite evident, that if the air chamber and the tube be filled by a condensing air pump, with air as highly condensed as the air in the bell while it rests upon the platform, the circular cover might be unscrewed, and that the workmen might first descend into the short leg, and then ascend through the long one into the chamber above, and so walk out dry upon deck, without taking the bell out of the water.

This, however, as I have said, was mere theorizing. Still an improvement, possible and practically useful, was the result of this theoretical non-impossibility; for it immediately suggested to me an air-tight chamber on deck, with windows in it like the bell of observation, and connected by a flexible tube with the working bell; and so gave, as an immediate consequence, a second mode of 'communicating,' by conversation, with the persons below.

Experiments with the Communicating Diving Bell—Related by a friend of Mr. Steele's.

The inventor before descending, placed a lighted lantern in the open compartment; he next entered the communicating chamber, through a circular aperture, which was firmly screwed down upon him; and he then gave orders to be lowered under water.

In this descent, the water was prevented from entering the open bell by the ordinary operation of the condensing air-pump upon deck; and Mr. Steele had consequently an opportunity of observing every thing within it strongly illuminated by the lantern; while, at the same time, instead of being obliged to endure the pressure of condensed air, and to depend upon signals by strokes of a hammer, he sat at his ease in air of no greater density than that of the atmosphere, and conversed through one of the pipes with his friends above water.

While he remained down, he described what he saw in the open bell, and gave such directions as circumstances rendered necessary. During this time, by simply turning a cock, he had the means of refreshing the air in his chamber at pleasure, by a current of condensed air from the open bell. After some time, he desired that they should heave up, which was done; the water-tight cover was unscrewed, and he came out evidently very much gratified by the success of his first experiment.

He next took his seat in the open bell, and a bell-man took the place he had just ceased to occupy. The communication between persons descending in this manner, is by writing; they write upon tablets, and mutually exhibit them at the window in the partition. They descended; the bell-man described what he saw to the persons above, and after they had been under water for some time, when Mr. Steele chose to ascend, he intimated his desire to him, and he immediately communicated the order that the bell should be raised. After they came out of the bell, preparations were made for putting the *second* proposed mode of communication to the test.

An air-tight chamber above water, with a window like the one already described, was connected by a flexible pipe with the open diving bell; the bell-man took his seat in this, one of the engineer's workmen went into the communicating chamber, and Mr. Steele himself, taking his tablets and pencil, went into the chamber above water, into which he was immediately fastened by an air-tight cover.

The bell was lowered under water, and of course the chamber above was filled, through the pipe, with condensed air.

At this moment a novel and complex system of communicating by conversation and writing, was thrown into action, instead of signals by the strokes of a hammer. Mr. Steele, in the air chamber above, held conversation with the bell-man below, and the man in the communicating chamber below, conversed with the persons upon the deck of the vessel. A gentleman stood close to the chamber above, and he and Mr. Steele exhibited writings to each other through the window. The latter wrote, among other things, that he had just asked the man below if he was anxious to be heaved up, and that he had been answered in the negative. The men then made some observations about the noise in the bell, caused by the rush of the condensed air through the valve, and about some other circumstances bearing relation to the experiment. At this time, Mr. Steele required some paper, and a sheet tightly rolled was given in to him through a cylinder passing through the side of the chamber. This was furnished with two cocks, one on the inside, and the other on the outside; so that the paper was transmitted without the escape of the air. Soon after this, I observed that he exhibited at the glass, an order for heaving up, and the bell was raised. When he was liberated, and while he was receiving the congratulations of his friends, I heard him say to one of them, that his feeling was one of extreme delight, at the moment when, looking out from the little window of the air-chamber, after the full success of his experiments, he saw his diving bell emerging slowly from the water, and the persons who had descended come out from it in safety.

Note by Mr. Steele.

The men in the working bell under water, are much more comfortable than the person in the air chamber above, although the condensation of the air be in both cases equal, as the air chamber becomes very quickly heated and oppressive, and the window looking out upon deck becomes dimmed so rapidly, that it must be frequently cleared, by rubbing it with a handkerchief. I think (but am not at all sure, not having yet proved it by experiment,) that I see a practical way of preventing this.

There is an exceedingly interesting, but apparently paradoxical consequence, resulting from the theory upon which the air chamber has been constructed. 1st. Let the diameter of the pipe between this chamber and the bell be supposed to be increased until it be sufficient to admit a man, and let a rope ladder be inclosed in it. 2nd. Let the air chamber be subdivided into two, with a man-hole in the partition, and another in the side. It is evident that, by a process analogous to that of passing locks in a canal, and identically the same with that used by Mr. Steele himself, in the transmission of the roll of paper through the two air tight cocks, a man might go down unwet from deck, to blast rocks, or do any other work at the bottom of the sea! The same thing might be effected by the addition of a third compartment to the bell below, between the communicating chamber and the open bell; in which case, the air chamber above water would (for this particular purpose,) cease to be necessary. It is manifest, however, that these two modes of passing and repassing between the deck and the bottom, might be used even in combination. [*Mech. Mag.*

¶ *Experiments on the Expansion and Contraction of Building Stones, by variations of Temperature; communicated by William H. C. Bartlett, Lieut. U. S. Engineers.*

Fort Adams, Newport Harbour, March 12, 1832.

TO PROFESSOR SILLIMAN.

Sir,—In the progress of this work, we have had occasion to use considerable quantities of coping stones, taken from different localities, with all of which it has been found impossible to obtain tight joints. The walls on which these stones were placed have not undergone the slightest change; and, notwithstanding they were laid with the greatest possible care, and their joints were filled with the best cements that could be devised, yet, at the expiration of a few weeks, these joints were broken up by fissures which extended from the top to the bottom of the coping. These fissures were supposed to have arisen from a change of dimensions in the coping stones, in consequence of the ordinary variations of atmospheric temperature; and, with the view to ascertain if the total amount of cracking could be attributed to this cause alone, a series of experiments was instituted by order of Col. Totten, and continued from August 18th, 1830, to June 2nd, 1831. The circumstances connected with these experiments, as well as their results, you will find subjoined. Col. Totten requests me to communicate them to you, supposing that you may find them of sufficient practical importance to deserve a place in your Journal.

These experiments were made, nearly at the same time, upon granite, limestone, and sandstone, the kinds of stone used for the coping; and for this purpose a piece of each was selected in such a manner that the three pieces were of nearly equal lengths. The granite has a fine grain, is of a compact texture, and was taken from a boulder at the head of Buzzard's bay: the limestone is white, has a fine grained crystalline structure, and accompanies primitive rocks; it was taken from the quarries of the Sing-sing State Prison, New York: the sandstone is from the quarries in Chatham, Conn., and belongs to the old red sandstone formation, according to the Rev. Edward Hitchcock;* it has a granular structure, rather coarse, and its cement is argillo-ferruginous.

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* He *now* refers all the sandstone of the Connecticut valley to the new; see the first article in the present No.

To ascertain the exact lengths of these pieces at the different temperatures produced by exposure to the weather—these alone being important for our immediate object, and for the purposes of construction generally,—the measurements were made by means of a white pine rod, with copper elbows at the ends embracing the stones when applied to them, as represented in the sketch.

Fig. 1.

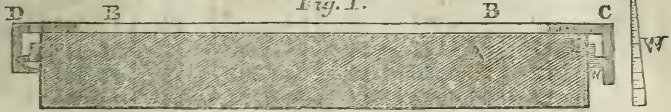
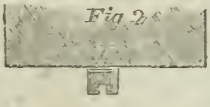


Fig. 2.



A A is an elevation, or vertical section lengthwise, of the stone to be measured; B B the measuring rod, with elbows, D and C, of thin hammered copper, firmly secured to it. The end D was always adjusted to the same part of the stone, by sliding through a groove in the copper guide F, cemented to the stone; the elbow C was adjusted in like manner by sliding through a groove in the piece E also attached to the stone. The elbow C has itself a groove through which the wedge W may slide horizontally, under the guide E, between the elbow C and the stone: this wedge, being graduated as a diagonal scale, showed, by the distance which it entered, the difference between the length of the measuring rod and that of the stone. The expansion of the measuring rod being known, the length of the stone could be calculated in decimals of a constant unit, viz. the English standard inch.

A groove was cut in the stone in which a thermometer was placed, at each measurement, and being covered, was suffered to lie some time, in order to ascertain the temperature of the stone. The temperature of the measuring rod was assumed to be that of the open air to which it had been exposed.

By Lardner and Kater's Mechanics, we have as a mean between the results of Capt. Kater and Dr. Struve for the linear expansion of deal wood in terms of its length for one degree of Fah. the decimal .00000255; and by the Edinburgh Encyclopædia, art. Expansion, we find the decimal .00000944 to express the same for hammered copper. From these data the actual length of the measuring rod was calculated for each experiment; knowing its length at sixty degrees Fah. But to abridge the calculation, the difference in length between the stone and measuring rod, as shown by the wedge W, was subtracted from the length of the rod before making the reduction for the temperature of the latter. The length of the copper part, and that of the wooden part, were calculated separately on account of their different expansibilities. The result of this calculation is the following table.

MARBLE.			GRANITE.		SANDSTONE.	
No. of Exper't.	Degrees Fah.	Length in inches.	Degrees Fah.	Length in inches.	Degrees Fah.	Length in inches.
1	6°	93.4155	6°	94.0251	6°	94.0180
2	7	93.4277	8	94.0330	8	94.0153
3	9	93.4201	9	94.0260	9	94.0052
4	10	93.4207	10	94.0265	10	94.0088
5	11	93.4131	11	94.0230	11	94.0124
6	12	93.4186	12	94.0282	13	94.0211
7	14	93.4174	14	94.0271	14	94.0206
8	14	93.4294	14	94.0347	14	94.0220
9	14	93.4308	14	94.0361	15	94.0235
10	16	93.4302	16	94.0285	15	94.0238
11	16	93.4291	16	94.0345	17	94.0214
12	17	93.4305	17	94.0358	18	94.0181
13	19	93.4327	19	94.0416	20	94.0239
14	20	93.4310	20	94.0364	22	94.0258
15	21	93.4316	21	94.0440	22	94.0263
16	31	93.4265	32	94.0324	32	94.0371
17	32	93.4352	32	94.0406	34	94.0466
18	34	93.4422	36	94.0330	38	94.0554
19	36	93.4360	36	94.0450	39	94.0436
20	36	93.4357	37	94.0483	39	94.0592
21	38	93.4436	41	94.0344	43	94.0486
22	52	93.4323	52	94.0348	53	94.0560
23	58	93.4450	62	94.0541	64	94.0718
24	83	93.4655	86	94.0720	93	94.0879
25	86	93.4649	88	94.0737	93	94.0829
26	90	93.4709	88	94.0688	95	94.0897
27	99	93.4677	89	94.0731	99	94.0941
28	.	. .	90	94.0693	100	94.0906
29	.	. .	91	94.0693	101	94.0944
30	.	. .	94	94.0628	104	94.0841
31	.	. .	102	94.0721	109	94.0792

It is probable that many of the discrepancies here noticed were owing to the hygrometric state of the stone; and perhaps, in part, to imperfections in the measuring apparatus; but as the hygrometric state of the stone was not recorded, we can take no account of it in our deductions. These discrepancies, however, will have but little effect upon the general result; for it will be observed, that there is always an increase in the length of stone for an increase of temperature, when any two experiments are considered which are removed from each other by several degrees.

From the facts ascertained concerning the expansion of other substances, we may assume that the expansion of stone is uniform, and that, within the range of our experiments, each of the stones increased in length by a common difference for each degree of the thermometer. To find an approximate value for this common difference, say for the granite, we subtract the first observed length from the last, and, if these experiments were accurate, the difference .0470, would be ninety-six times the common difference: ninety-six being the difference in degrees between the extreme temperatures: the same operation being performed with the second experiment, and that next the last; the difference .0298, (the difference in lengths,) should be eighty-six times the common difference. By thus comparing the extreme experiments of those which remain, we obtain the following table.

Experiments.	Diff. in degrees.	Diff. in lengths.
1 and 31	96	+.0470
2 and 30	86	+.0298
3 and 29	82	+.0433
4 and 28	80	+.0428
5 and 27	78	+.0501
6 and 26	76	+.0406
7 and 25	74	+.0466
8 and 24	72	+.0373
9 and 23	48	+.0180
10 and 22	36	+.0063
11 and 21	25	—.0001
12 and 20	20	+.0125
13 and 19	17	+.0034
14 and 18	16	—.0034
15 and 17	11	—.0034
Total,	817	.3708

We have neglected the sixteenth experiment, because we cannot employ it without using some other experiment twice, thus giving the latter an undue influence; and because the middle term should have the least weight in determining the common difference.

By the above table, we find, as the combined result of all the experiments, that .3708 should be eight hundred and seventeen times the common difference; and hence the common difference for one degree of Fah. is .0004538 inch. Now, assuming 94.05 inches, as the mean length of the granite, which is sufficiently near, we find the linear expansion for one inch of stone for each degree of Fah. to be $\frac{.0004538}{94.05} = .000004825$ inch, and for one foot this expansion would be .0000579 of an inch. By proceeding in the same way with the experiments on the other stones, we obtain the following results.

Mean whole length in inches.		Common difference in inches for the whole length of stone for one degree of Fah.	Common difference in inches for one inch for each degree of Fah.
Granite,	94.05	.0004538	.000004825
Marble,	93.44	.0005297	.000005668
Sandstone,	94.05	.0008965	.000009532
White pine,		- - -	.00000255
Hammered copper,		- - -	.00000944

To apply these results to the case in question, let us suppose two coping stones of five running feet each, to be laid in mid-summer, when they have a temperature of ninety-six degrees Fah.; in winter their temperature may safely be assumed at zero, so that the total variation of temperature will be ninety-six degrees; and if we suppose these stones to contract towards their centres, which would be the most favourable supposition as regards the tightness of the joints where a number of these stones are used, the whole length of stone put in motion by a change of temperature would be five feet. If the coping be of granite, the distance by which the ends of the stones would be separated, in consequence of *one* degree's variation, would be sixty inches multiplied into .000004825 = .0002895, and for a variation of ninety-six degrees, this distance becomes .0002895 × 96 = .027792 inch, giving a crack a little wider than the thickness of common pasteboard. For marble, this crack would have a width of .03264, nearly twice the thickness of common pasteboard; and for sandstone .054914, nearly three times the thickness of pasteboard. These cracks are not only distinctly visible, but they allow water to pass freely into the heart of the wall. The mischief does not stop here: by this constant motion back and forth in the coping, the cement, of whatever kind the joints might be made, would be crushed to powder, and in a short time be totally washed by the rains from its place, leaving the whole joint open.

[*Amer. Jour. of Sciences and Arts.*

¶ *First Report of the Proceedings of the British Association for the Advancement of Science, assembled at York.*

The appearance of this report has put the scientific public in possession of the authorized account of what has been done by this very important society, and of what may be expected from its exertions.

We cannot but consider that the British Association has started under auspices the most favourable, and even the results of the first meeting, and the prospects of support which this report displays, certainly exhibit a much greater step towards the fulfilment of a great series of objects requiring much time for their development than could possibly have been anticipated.

That the Association has already secured in its favour a great share of the best talent in the country, the list of members annexed to the report will best testify; it is in every respect a most creditable phalanx of names. Fortunately, however, it is not upon names alone, that its prospects of support must rest; the pamphlet before us contains pledges of exertion from some of the most active philosophers in the country, of a description which has been unattempted by any previously existing society among the many which this country possesses. There is no society, strictly scientific, which professes to direct the attention of its members, or of philosophers at large, to particular branches of knowledge, in which important progress might be made by a well directed system of mutual co-operation. Take, for example, the science of meteorology, in which observers have been so long at cross purposes, and in which the very same amount of exertion, which has been thrown away upon forming registers utterly useless for want of information or combined exertion, might have been rendered available to the highest purposes of science. To this subject the Association has properly directed peculiar attention, and, it may be hoped, with the happiest results.

But there is nothing which strikes us with more admiration amongst the energetic proceedings of this infant institution, than the list of reports on the state and progress of the different sciences. This is a species of literature quite new in this country, and which will form a body of information really invaluable. The only approximation to it has been in the annual addresses of the president of the Geological Society upon that particular branch of science. These admirable discourses have only excited the wish that something more general, upon the same plan, should be attempted. The objects of these scientific reports will, we believe, be more varied and extended; and it is probable, that, for the first year at least, the style of execution of them will much depend upon the views and opinions of the individuals by whom they are composed, until some formal plan shall have been sanctioned by usage for general adoption. Some account of the different labours of philosophers during a recent period of time, with a view of their bearing upon the past progress and future prospects of the sciences, will, we presume, be a general object of these reports; but we trust that in many of them more extended and philosophical generalizations will be taken; and in several sciences we do not know a more acceptable service that could be performed, than a correct estimate of the precise point to which our knowledge has arrived, and where precisely our ignorance begins. From this process some conclusion will naturally be drawn as to the line, or lines, which present the fairest points of attack upon the remaining strong holds of science.

The names of those who have engaged to execute these useful labours in science include some of the most active philosophers in Britain; and we anxiously hope that nothing will deter those who have given this capital portion of the machinery of the Association the weight and sanction of their names, from fulfilling, in as full a manner at least as leisure will permit, the agreement to which they are in some measure pledged, and which will be valuable to science and to the Association, in proportion to the acknowledged eminence of their scientific character.

As we cannot but look upon this as one of the most important parts of the pamphlet before us, we shall insert the list of reports contained in the preface.

"1. The Rev. George Peacock has undertaken to present to the next meeting, a report on the recent progress of Mathematical Analysis, in reference particularly to the differential and integral calculus.

"2. Professor Airy has undertaken a report on the state and progress of Astronomical science, in reference particularly to Physical Astronomy.

"3. J. W. Lubbock, Esq. has consented to furnish such information respecting the data and desiderata for calculating the time and height of High-Water as he may be able to offer.

"4. James D. Forbes, Esq. has undertaken to present a report on the present state of Meteorological science.

"5. Dr. Brewster has undertaken a report on the progress of Optical science.

"6. The Rev. Robert Willis has undertaken a report on the state of our knowledge concerning the Phenomena of Sound, in reference especially to the additions recently made to it.

"7. The Rev. Professor Powell has undertaken a similar report respecting the Phenomena of Heat.

"8. The Rev. Professor Cumming has undertaken a report on Thermo-Electricity, and on the allied subjects in reference to the discoveries recently made in them.

"9. James F. W. Johnston, Esq. has undertaken a report on the recent progress of Chemical science, especially in foreign countries.

"10. The Rev. Professor Whewell has undertaken a report on the state and progress of Mineralogical science.

"11. Robert Stevenson, Esq. has undertaken the report recommended by the Geological and Geographical Committee, on the waste and extension of the land on the east coast of Britain, and on the question of the permanence of the relative level of the sea and land.

"12. Professor Lindley has undertaken to give an account of the principle questions recently settled, or still agitated, in the Philosophy of Botany."

No less than six of these twelve reports are to be contributed by eminent members of the University of Cambridge,—a circumstance certainly highly indicative of the warmth of feeling of that great body towards the objects of the British Association, as well as giving a pledge for the ability of the works thus undertaken. The former distinguished professor of mineralogy at Cambridge was among the earliest supporters of the plan, to which he alluded in a letter communicated to the York meeting, an extract from which is given in Mr. Vernon Harcourt's address. "A collection of reports," he says, "concerning the present state of science, is on all accounts much wanted, in order that scientific students may know where to begin their labours, and in order that those who pursue one branch of science may know how to communicate with an inquirer in another. For want of this knowledge we perpetually find speculations published which show the greatest ignorance of what has been done and written on the subjects to which they refer, and which must give a very unfavourable impression of our acquirements to well-informed foreigners."—Report, p. 29.

The report is divided into three distinct portions, as the title page indicates. The first contains the proceedings of the meeting towards the constitution of the permanent body or association which sprung from it, and the subsequent arrangements necessary to its complete constitution. The second part embraces the proceedings of the general and the sub-committees appointed to carry into effect the objects of the Association, and which, it will be seen, were by no means limited to the week of the meeting at York. The third division contains the scientific transactions of the meeting at York, comprising the order and periods of the meetings, with abstracts of the papers presented. One communication, printed at full length, is the excellent essay of Dr. Henry, of Manchester, upon the philosophical character of Dr. Priestley.

It is not our intention to enter into any analysis of these several departments. But we feel it to be only due to the very able address of Mr. Vernon Harcourt, the real originator of the *permanent* association, to make one or two quotations from it; for we view it as an address differing much from what is too often found upon such occasions, as perfectly free from affectation, as abounding in the soundest views of the present state of science, and written in a manly and highly perspicuous style.

The following passage sets in a true light the bearing of the new association upon already existing societies:—"It is not by counting the great luminaries who may chance to shine in this year, or that,—in a decade of years, or a generation of men,—that we are to inform ourselves of the state of national science. Let us look rather to the numbers engaged effectually, though less conspicuously, in adding by degrees to our knowledge of nature; let us look to the increase of scientific transactions and journals; let us look, gentlemen, at the list produced this day of philosophical societies which have grown up in all parts of the kingdom. The multiplication of these new and numerous institutions indicates a wide extension of scientific pursuits. The funds so liberally contributed to their support bear evidence of an enlarged disposition in the public to promote such pursuits.

"It is on this very ground I rest the necessity and the practicability of establishing in science a new impulsive and directive force, that there are new and more abundant materials to be directed and impelled. The mining field of discovery seems to me to show, on the one part, the ore breaking out on every side; veins of the precious metal scarcely opened or imperfectly wrought; and on the other a multitude of hands ready to work it, but no one engaging them to labour, or showing them in what manner they may employ their industry to the best advantage. And therefore it is that I propose to you to found an Association, including all the scientific strength of Great Britain, which shall employ a short period of every year in pointing out the lines of direction in which the researches of science should move, in indicating the particulars which most immediately demand investigation, in stating problems to be solved and data to be fixed, in assigning to every class of mind a definite task, and suggesting to its members, that there is here a shore of which the soundings should be more accurately taken, and there a line of coast along which a voyage of discovery should be made.

"I am not aware, gentlemen, that in executing such a plan we should intrude upon the province of any other institution. There is no society at present existing among us, which undertakes to lend any guidance to the individual efforts of its members, and there is none, perhaps, which can undertake it. Consider the difference, gentlemen, between the limited circle of any of our scientific councils, or even the annual meetings of our societies, and a meeting at which all the science of these kingdoms should be convened, which should be attended, as this first meeting you see already promises, by deputations from every other society, and in which foreign talent and character should be tempted to mingle with our own. With what a momentum would such an association urge on its purpose! what activity would it be capable of exciting! how powerfully would it attract and stimulate those minds, which either thirst for reputation or rejoice in the light and sunshine of truth!"

[TO BE CONTINUED.]

Notice of Electro-Magnetic Experiments.

[Communicated by Prof. A. D. BACHE, of the University of Pennsylvania.]

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN,—I send you a description of the apparatus for producing the spark from a magnet according to the method of Nobili, and for other recent and curious experiments on electro-magnetism, together with an account of their repetition. This is done that any one who may be desirous to repeat or to extend the experiments may, without delay, be put in possession of the means of so doing.

Extract of a letter from J. Saxton, of Philadelphia, to Isaiah Lukens, dated London, April 14th, 1832.

"You may have heard of Faraday's curious discovery in electromagnetism. He has succeeded in obtaining from a magnet a spark resembling the electric spark. The apparatus consisted of a copper plate mounted on an axis, like an electrical machine, and made to revolve between the poles of a large magnet. The plate used was about one foot in diameter, and one-eighth of an inch in thickness. The rim of the wheel was amalgamated, as well as a ring around the axis. Two pieces of copper, shaped to fit, for two or three inches, the amalgamated ring and the circle, were attached to either wire of a galvanometer. These pieces of copper being applied to the wheel, and the latter turned, the needle of the galvanometer vibrates: the amount of vibration may be increased by alternately touching and removing one of the plates. The copper plate which touches the rim should be between the poles of the magnet.

"I have made this experiment in a different way and succeeded satisfactorily. The method was as follows. A coil of wire wrapped with silk, similar to that used in the galvanometer, was attached by the ends to the wires of the galvanometer. On passing this roll backward and forward upon one of the poles of a horse-shoe magnet, or placing it upon and removing it from either pole, I have made the needle of the galvanometer spin round rapidly."

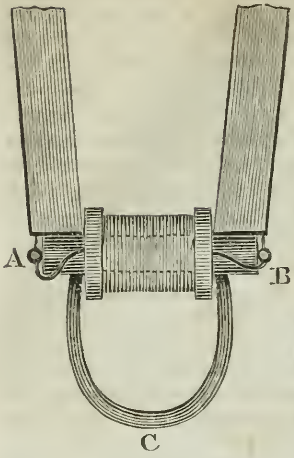
Extract of a second letter from J. Saxton, of Philadelphia, to Isaiah Lukens, dated London, May 11, 1832.

"Since my last I have heard of a method of producing a spark from a magnet, discovered, I believe, by an Italian. This experiment I made at once upon a large horse-shoe magnet which I am making for Mr. Perkins and his partners. One of your large magnets will answer the same purpose. Make a cylinder of soft iron of an inch, or three-fourths of an inch, in diameter, and of the usual length of the keeper; place two disks of brass or wood upon this cylinder, and at such a distance apart that they will conveniently pass between the poles of the magnet; between these wind, say fifty feet of, bobbin wire, which may be of iron covered with cotton; let the ends of this coil be bent over the ends of the cylinder and brought down until they touch the poles of the magnet, the ends should be of such a length that on bringing the cylinder to the magnet, one of the ends will touch when the cylinder is about half an inch from the magnet, and the other at one-fourth of an inch. The cylinder being thus arranged, and in contact with the magnet, on drawing it suddenly away a spark will pass between the end of the wire and the pole of the magnet."

The apparatus alluded to in these letters was, soon after their receipt, put together by Messrs. Isaiah Lukens and Benjamin Say; it is figured in the cuts which follow.

Fig. 1 represents the apparatus of Nobili for procuring the spark

Fig. 1.



from a magnet. A, B, is a cylinder of soft iron, upon this are two brass rims, between which bobbin wire (wrapped wire of iron and copper were both successfully used,) is wound; the ends of the wire coil are carried out at the opposite ends of the cylinder, and being bent downwards pass through holes in two brass (or wooden) pins. The spring of the wire causes both the ends to touch the magnet when the keeper is attached, when it is withdrawn one end projects beyond the other.*

This apparatus has been improved by Mr. Lukens by coiling the ends of the wire into a spiral, thus forming a spring to press the points of the wire against the poles of the magnet; and by carefully insulating the ends in their passage through the brass stems.

From this improved apparatus a spark can be obtained on *removing* the keeper with seldom a case of failure; frequently two sparks appear, one at each end of the wire, and in some experiments of Messrs. Lukens and Say a third spark was seen to pass from one of the brass rings. I have very frequently obtained sparks also by rapidly *replacing* the keeper.

To ascertain the nature of this spark, I endeavoured to determine whether the removal of the keeper which produces the spark was attended with any electrical effect which would warrant the supposition that this was an electric spark.

The cylindrical keeper, arranged as at first described, was used for this purpose. The ends of the wires spoken of as touching the poles of the magnet were bent outwards, to remove them from the poles, and connected with the wires of a galvanometer. On approaching the keeper to, or drawing it from, the magnet, an agitation of the needle of the galvanometer was produced, demonstrating the existence of a current of galvanic electricity, to which, therefore, the spark is probably due.

A few turns, say four or five, of iron bonnet wire about the keeper of a magnet, which supported, by a contact with its whole surface, fifty pounds, produced a very sensible vibration in the needle: the contact and removal being made at times tending to increase the arc.

In the experiments of MM. Nobili and Antinori, the account of which has been received since those which I have described were made, it seems that this development of a galvanic current which they observed led them first to suspect that the spark might be obtained.

The following observations were made at the same time with those above described, on the direction of the galvanic current. The needle of the galvanometer used, was suspended by a fibre of silk; upon the stand of the instrument were two brass cups in the same plane with the coils of the wire surrounding the needle; into the cup corresponding to the south pole of the needle, the wire passing from south to north *above* the needle, and from north to south below, was placed; into the north cup was inserted the opposite wire. Thus arranged, a current of galvanism passing from south to north will deflect the north pole of the needle to the west; by a current passing from north to south the north pole of the needle will be deflected to the east. The galvanometer was covered by a glass receiver to prevent agitation from currents of air. The magnet used was the one alluded to above as supporting fifty pounds, this is a horse-shoe magnet, made of ten magnetic bars, the keeper being filed off in front applied itself to two of these.

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* This condition appears by subsequent experiment to be by no means essential.

The magnet being placed with its poles to the south, (the north pole being westward) the keeper was brought to the magnet in such a position that the coil was directed *above* the cylinder from *north to south; below* from *south to north;* the wire from the *upper side* was dipped into the mercury of the *south* cup of the galvanometer; the wire from the *under* side into the *north* cup.

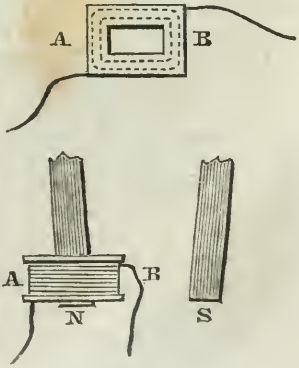
On drawing the keeper from the magnet, the north pole of the needle of the galvanometer passed to the west; the needle being allowed to return to the meridian, a return of the keeper to the magnet deflected the north pole to the east. By assisting the needle in its vibrations by the alternate withdrawal and return of the keeper, a very considerable vibration was produced.

By changing the keeper from right to left so that the wire passing *over* the cylinder was directed from *south to north,* the communications with the galvanometer remaining as before, the reverse of the deflections just described took place.

The effects described may be represented by a galvanic current circulating around the keeper, and at right angles to its axis, directed from north to south above the cylinder when the keeper was withdrawn, in the contrary direction when it was returned. Such a current would evidently have passed out of the upper wire on the withdrawal of the keeper, and out of the under wire on its return; that is, would have passed from south to north, above the needle of the galvanometer, in the first case, and from north to south in the second.

Fig. 2 shows the apparatus for producing vibration in the needle of the galvanometer by the wire coil and magnet. A, B, is a roll of wrapped wire wound about a wooden spool, which has the central part removed; the ends of the wire are connected with the wires of a galvanometer; this roll is represented in the lower part of the figure as placed upon the north pole of a horseshoe magnet, by passing it to and fro

Fig. 2.



upon the leg of the magnet, or by alternately removing and replacing it upon the pole, a vibration is produced in the needle of the galvanometer. The wires are continued to such a length as to prevent the direct action of the magnet upon the needle of the galvanometer.

Some experiments which, by the kindness of Mr. Lukens, I was enabled to make with this apparatus, resulted in a satisfactory mode of representing the effect which is produced upon the galvanometer in any given position of the coil. I offer it simply as a mode of recollecting the results of observation.

The coil of wire (fig. 2,) was first applied to the north pole of the magnet, the direction of the coil being from right to left above the magnet, the inside wire of the coil was on the left hand, the outside wire on the right, the experimenter facing the north; the outside wire was carried to the south cup of the galvanic multiplier, the inside to the north cup. The poles of the magnet were turned to the south. On withdrawing the coil from the pole, the north pole of the needle was deflected to the west; returning the coil, carried the same pole to the east. Changing the wires of the coil in the cups of the galvanometer reversed the direction of the vibration of its needle.

The effect of withdrawing the coil would have been produced by a galvanic current passing through the coil from left to right below the magnet, from right to left above it.

The coil was next changed from right to left; that is, the direction of the coil changed so that it passed from right to left below the magnet, and from left to right above it; the wires which dipped into the cups of the multiplier remained in their places; the inner wire was now to the right hand, the outer wire to the left. On removing the coil from the north pole of the magnet, the north pole of the needle of the multiplier passed to the east, on returning the coil the same pole moved to the west.

This effect would (as before,) have been produced by a galvanic current passing from left to right below the magnet, from right to left above it. The other positions of the coil being examined showed that they might be represented by the same supposition of a circular current about the pole of the magnet, and passing through the wire. The reverse of such an hypothesis is of common application to represent the action of the conjunctive wire of a galvanic battery upon a magnetic needle.

The south pole of the magnet presented opposite results, the effects produced by removing the coil were such as would have occurred in replacing it upon the north pole.

As the removal of the coil produces a contrary effect from that obtained when it is placed upon the pole, the representation is complete from the opposite magnetic currents produced in these cases. When the coil is drawn along the magnet towards the north pole, it is easy to conceive that passing successively to more magnetic parts, or exposed to magnetism of different intensities, the current of magnetism, with regard to the wire, is from south to north; this, by the reversion of the hypothesis in relation to the galvanic current, produces (since the north pole is towards the operator,) an electrical current from west to east, or from left to right, below the magnet. The same is true for the south pole.

We conclude that the effects of a magnet upon a coil of wire may be represented by an electrical current at right angles to the direction in which the wire moves upon the magnet, and directed below the magnet from west to east when the coil is moved from the south pole to the north pole of the magnet, and vice versa, the poles of the magnet being turned to the south.

The denominations will change of course if it be considered more convenient to turn both poles to the north.

It would seem easy to bring the facts relating to the removal of the keeper upon which wire is coiled, under the same expression. In that case the magnetism is in motion with respect to the coil, leaving the soft iron which forms the keeper.

With fifteen turns of copper wire upon the prismatic keeper of the magnet before used, a vibration through twenty degrees, at the maximum, was produced; beyond this the power of the current could not carry the needle. The wire was wrapped with silk.

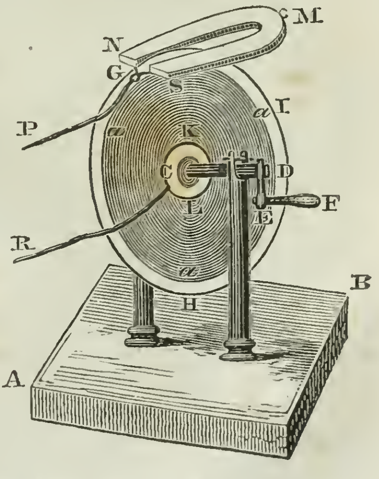
With five turns upon the same keeper a vibration through an arc of ten to twelve degrees was obtained.

The coil being at rest upon the magnet no permanent deflection is produced. This agrees with an observation of Nobili and Antinori.

The amount of vibration may easily be increased by providing two coils, one for each pole, the direction of the coils being opposite to each other, the outer wires of each coil being united as well as the inner ones, the effect of two coils would be produced. They may be separated by a piece of wood, to which being attached, and the wood provided with a handle, the coils may be removed or replaced very conveniently.

Fig. 3 represents Faraday's wheel; G, H, I, being a piece of copper 12 inches in diameter, the circular ring between G, H, I, and *a*, *a*, *a*, is amalgamated, also the ring K, L, near the centre of the plate on the same side with the first ring; the wheel is mounted upon an axis C, D, and turned by a winch. K, L, and G, are plates of copper, to apply the one at the amalgamated ring around the axis, the other at the ring at the circumference and between the poles, N and S, of a horse-shoe magnet. G, P, and C, R, are the wires soldered to these plates, their extremities connected with the galvanometer as described above, their length adjusted upon the same principles.

Fig. 3.



In experimenting with Faraday's wheel, the disk K, L, at the centre was pressed constantly against the wheel by fastening a cork between the disk and the support. The piece of copper G was touched to the wheel at intervals so as to assist the vibrations or to destroy them at pleasure. When the wheel was first amalgamated, a deflection in the needle was produced without the aid of the magnet; afterwards no such deflection was observed. Opposite rotations of the wheel produce opposite effects in deflecting the needle of the galvanometer, other parts remaining the same.

Meteorological Observations for May, 1832.

Moon.	Days.	Therm.		Barometer.		Dew point	Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Sun rise.	2 P.M.		Direction.	Force.		
				Inches	Inches.				Inches.	
	1	44°	63°	29.84	29.80	37	W.	Breeze.		Cloudy—flying clouds.
	2	43	63	.90	.93	37	NE. W.	Light.		Clear day.
	3	41	66	.93	.93	40	SE. S.	Calm.		Lightly cloudy—clear.
	4	47	76	.80	.70	61	SE. S.	Blustering.	.13	Light clouds—clear—rain [in night.
	5	61	59	.50	.60	46	W. NW.	Moderate.		Cloudy day.
	6	45	67	30.00	30.10	37	NW. SW.	do.		Lightly cloudy—clear.
☽	7	42	67	.25	.25	34	SE.	do.		Foggy—clear.
	8	48	76	.20	.10	54	SE. S.	do.		Cloudy—light clouds.
	9	56	72	.10	.10	57	S. W.	Breeze.	.25	Rain—cloudy.
	10	52	74	.20	.25	34	NE. SE.	do.		Light clouds—clear.
	11	42	68	.35	.40	29	NE. SSE.	do.		Clear day.
	12	42	75	.30	.30	52	SE. SW.	do.		Clear day.
	13	50	78	.10	.20	55	SW.	do.		Clear—overcast.
🌝	14	60	80	.00	29.95	63	S.	do.		Cloudy—showery.
	15	64	62	29.83	.74	64	S.	do.	.50	Showers—rain.
	16	54	78	.74	.80	50	W.	Blustering.		Lightly cl'dy—fly'g. cl'ds.
	17	55	79	.90	.90	49	NNE. W.	Moderate.	.09	Clear day—rain in night.
	18	59	78	.80	.80	59	SW.	do.	.03	Cl'dy—fl'g cl'ds.—rain n't
	19	57	84	.60	.70	65	SE.	Blustering.	2.00	Cl'dy—fl'g cld's—thund.
	20	57	56	.60	.60	56	SW. W.	Moderate.	.17	Cl'dy-showery. [r'n. hail.
	21	46	68	.60	.64	33	W.	Blustering.		Clear day.
☾	22	47	71	.83	.83	34	W.	Moderate.		Clear day.
	23	48	60	.90	.90	43	SSE. E.	do.		Light clouds—cl'dy—rain.
	24	45	46	.70	.70	43	E. E.	do.	1.15	Rainy day.
	25	43	64	.80	.80	40	NW.	do.		Cloudy—flying clouds.
	26	44	58	.70	.60	54	NW.	do.	.65	Clear—rain.
	27	44	64	.40	.50	35	W. NW.	do.		Clear—flying clouds.
	28	45	66	.70	.75	44	W.	do.		Clear—flying clouds.
⊗	29	50	79	.84	.90	44	W.	do.		Clear day.
	30	56	56	.60	.90	53	W.	Blustering.		Rain—showery.
	31	46	57	.55	.50	46	E.	do.	.45	Rain—cloudy.
	Mean	49.47	66.77	29.85	29.87	46.7			5.42	

	Thermometer.	Barometer.
Maximum height during the month,	84. on 19th.	30.40 on 11th.
Minimum do. . .	41. on 3d.	29.40 on 27th,
Mean do. . .	58.12 . .	29.86

JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

DEVOTED TO THE

MECHANIC ARTS, MANUFACTURES, GENERAL SCIENCE,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

AUGUST, 1832.

Suggested improvements in the Construction of Barker's Mill.

By James Whiteland.

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

New York, June 5, 1832.

Sir,—The accompanying is a drawing* of what I consider an improved form of Dr. Barker's mill: you will very much oblige me by giving it, and the following description, a place in your journal.

The mill is represented as working a little off the wall of a building. At the top of the drawing, and behind the bevel wheels, a cast iron wall-plate is shown, for fixing the pillow block into which the horizontal shaft (for working machinery inside of buildings, on which the upper bevel wheel is fastened,) turns. On the under side of this plate a cast iron trough, for conveying water into the mill, is fixed; the trough terminates in a cylinder just so small in diameter outside, as to work clear of the inside of the upright cylinders of the mill. This cylinder is so long, and the holes at bottom are so shaped as to admit the water with the velocity, and in the direction, of the water in the upright cylinder of the mill. Inside of the trough cylinder is a smaller cylinder through which the upright shaft works: at the top is a larger part for holding brasses for steadying the shaft. Under the trough cylinder is the cylinder of the mill, made of wood, and hooped as shown. At the bottom of this cylinder the arms of the mill are fixed; they are of a *curved form.* Behind the mill is a niche for the arms to work in. At the bottom of the niche is a circular trough higher round its outer edge to receive the water after it has escaped from the mill: it is shown by the two ellipses at the bottom of the drawing. Below the mill is seen a square pit, for holding the step, into which the foot of the upright shaft works. The other parts of the drawing will be so easily understood as to make further description unnecessary.

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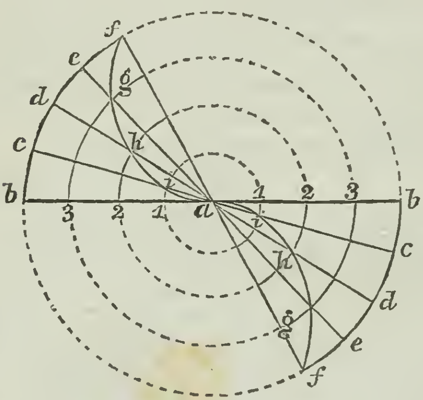
* See cut on page 76.

The *curved form* of the arms is what constitutes the difference of this and Dr. Barker's plan of the mill. The curve is such, that the water will run from the centre to the extremity of the arms in a *straight line* when the machine is working: by this arrangement no centrifugal force is given to the water, as it has not received any rotatory motion from the arms; which it would have had, had the arms been straight.

The nature of the curve *f*, *g*, *h*, *i*, *a*, of the arms will be understood by the annexed diagram. Let *a* be the centre, and *a b* the distance to the centre of the upper stone from which the water flows; also let the concentric circles 1, 2, 3, divide this distance into equal parts; and take *b*, *f*, equal to the distance that the extremity of the arms would pass, in the time that a particle of water would flow from the centre *a*, to *b* the extremity of the arms. Divide *b*, *f*, into the same number of equal parts that the distance *a*, *b*, is divided, and from these points, let the lines *ca*, *da*, *ea*, be drawn to the centre. Now, since the motion of the water is uniform, and the motion of the arms uniform also, while the arms revolve from *f* to *e*, a particle of water leaving the centre at the time the arms were at *f*, shall have passed from *a* to 1; and the points *i* and 1 will coincide; also when the arms move from *f* to *d*, the water shall have passed from *a* to *h*, and the points *h* and 2 will coincide; and so for the other points: when the water arrives at 4, the point *g* in the arms will coincide with 3; and when the particle moves to the point *b*, the arms will have passed also to the same point, and *f* and *b* will coincide.



Since by this arrangement there is no additional motion given to the effluent water by centrifugal or any other force, till the velocity of the extremity of the arms becomes greater than the velocity of the water, all that we have to consider in estimating the power of this machine when working at any velocity less than that of the water, is the effect that a quantity of water, having the velocity that a body would acquire in falling from the top of the mill to the level of the jet holes, would produce, when working at different velocities.

The weight that will stop the mill must be equal to the weight of a column of water twice the height of the water in the mill on a base the sum of the areas of the pit holes. For it is evident that if the holes be shut up there will be a pressure on all sides equal to the weight of the column in the mill; let, now, the holes be opened, the pressure on the opposite side will remain as formerly, and the water being set in motion by an equal pressure, the reaction, (since action and reaction are equal and contrary,) will give another pressure equal to the former one, on the sides opposite the holes. Therefore these two forces will give a pressure equal to the weight of a column of water twice the height of the water in the mill, on a base equal in area to the sum of the areas of the pit holes.

When the mill is working at the velocity of the water, it will raise a weight, equal to the weight of a column of water, the same height as the water in the mill, on a base the sum of the areas of pit holes; and the effect will be a maximum, and equal to the whole power of the water. For it is evident that as the water flows with the same velocity as it did before, the force of reaction will remain as great as ever, and will just balance the above weight or one-half of the weight that will stop the mill. And the other force being caused by the pressure of the water on the areas opposite the holes, must cease when it has brought the velocity of the mill up to the velocity of the water, as this is as quick as the water can follow it. Therefore, with two forces, one to balance a weight equal to the pressure on the areas opposite to the holes, and the other to keep this weight in motion at the velocity of the water, an effect equal to the whole power of the water will be produced. For in the time that the water flows with the velocity that it left the mill, a length equal to the height of water in the mill, this quantity of water, or an equivalent weight, can be raised to the top of the mill.

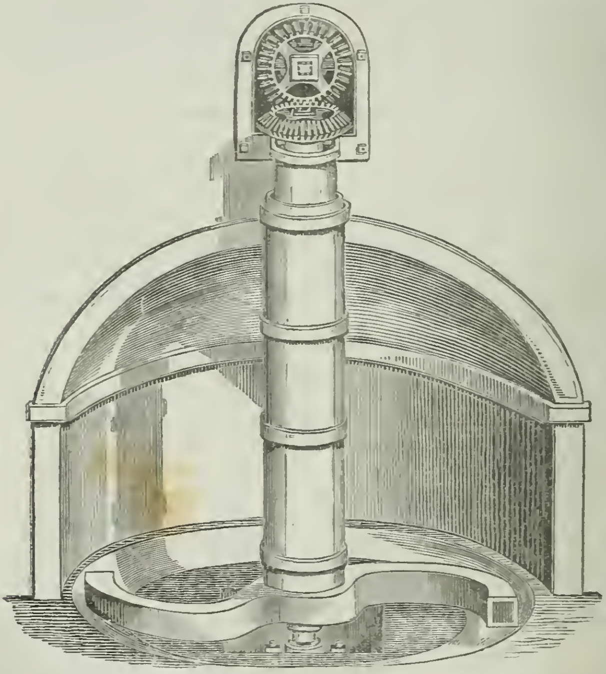
The effect for the other velocities may be determined in the same way. When the velocity of the mill becomes greater than the velocity of the water, if there is no centrifugal force the weight that the mill will work with must be the force of reaction, minus the force required to carry the water round with the mill.

If the above theory is correct, I need say nothing of the advantages that this form of the machine has over the other forms, as, indeed, over every other water mill. By considering how much power remains in the water after it has escaped from the mill, when working at different velocities, the same results may be obtained; an additional proof of the correctness of the above theory: thus, when the mill is standing, the water escapes with its whole force and no effect is produced. When working at the velocity of the water the mill moves as quick as the water, and the water, after it has escaped, has no motion in any direction, but falls directly down. Now, since there is no power remaining in the water, its whole power must be spent in producing an effect equal to its power in keeping the mill and resistance in motion. The power when the mill is working at one-half, or any other velocity, may be determined in the same way. As the motion of the mill is just as quick as that of the water, the portion of the circumference b, f, must be taken equal to the length of the radius or arms, if the areas of the holes and arms are alike: if the holes be smaller than the arms, the portion b, f, must be longer in the same proportion, as the water moves slower along the radius.

A rotary steam engine might be made in this way by sending steam through a mill working inside of a condenser. The steam pipe might be connected to the steam wheel by a metallic packing. If the wheel was large in diameter, there would be very little friction, as it would require so small a pipe in proportion to the power of the engine. The power might be taken from the steam wheel, and the motion reduced by letting the axis of the wheel rest on friction rollers, and the power taken off the axis of the rollers by means of toothed wheels, or other rollers. Another method would be to force water or any other liquid through a machine of this sort by steam.

Yours, &c.
James Whiteland.

Barker's Mill.



FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Remarks on the Explosions of Steam Boilers. By John D. Ward, *of Vergennes, Vermont.*

The June No. of the Journal of the Institute contains a letter from Thos. Ewbank on the causes and means of preventing explosions of steam boilers. In the course of his remarks he mentions a safety pipe (which is only a modification of the contrivance known among workmen by the name of "a feed head,") and gives an account of one on board the steam-boat M'Donough, on lake Champlain, which is inaccurate in some of its details.* As the engine was made by John D. Ward & Co. of Montreal, designed by myself, and built under my superintendence, I beg leave to set Mr. Ewbank right in the following particulars. The engine was built and set to work in 1828, and the safety pipe, or feed head, formed part of the original design, and was *not afterwards added;* its height was originally about thirteen feet, instead of twenty, and it was not intended that the engine should ever be worked with a greater pressure than four pounds per square inch; however, during the ensuing winter an ignorant engineman persuaded the proprietors of the boat that the boilers were sufficiently strong to bear a much greater pressure than had been used, and that it was only necessary to raise the feed head to enable him to double the pressure. His representations induced them to order the necessary pipes for that purpose from our foundry at a time when I was absent in Europe, and I learned with regret on my return that the engine was then at work with nearly twice the pressure of steam for which it was originally intended. The feed head is now about eighteen feet high, and may have been plugged up on some occasions; for the same ignorance and recklessness of consequences which led to raising it would lead to plugging it also; and both the one and the other having been done by the same person with impunity, his temerity will probably only end with his life.

I beg leave further to remark that the apparatus was neither expected nor intended to serve as a safety pipe any further than to prevent the engine man from using a greater pressure of steam than the engine was designed for, and they never can be made to supply the place of a safety valve for relieving a boiler from an extra pressure of steam without being of a size that will be found extremely inconvenient in practice, as every man will readily see who understands the subject.

With regard to the causes of explosions which have happened, and the means of preventing them in future, I think a great deal more ingenuity has been exercised than was called for by the difficulties of the case, especially in seeking for the causes of them. The real cause of nearly, if not quite, all the explosions that have happened, was a dangerous and unnecessary pressure of steam; amounting always to from fifteen to one hundred and fifty pounds, or upwards, per square inch.

The consequences which have resulted from using such pressure is a sufficient proof that it is dangerous; and that it is unnecessary is evident from the fact that a well made steam engine may be worked more economically with four pounds per inch than with a greater pressure. Hence if a certain amount of power is required on board a steam-boat it will be better to use a large engine and low pressure than a small engine and high pressure, because in the first place the low pressure is perfectly safe, and in the second place it is the cheapest. Perhaps the last position may be disputed, and it may also be said that the weight of the larger engines will be so great as to prevent the boats from having the great speed so desirable at the present day. To the first it may be replied that any addition to the first cost will be more than compensated by the subsequent saving in the cost of fuel. And to the second, that the weight of the fuel saved in a passage of any considerable length will be more than any extra weight required in the engine.

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* There appears to us to be a strict accordance between the facts stated by Mr. Ewbank, and those given by Mr. Ward: as we understand Mr. Ewbank, he says that the pipe *was* put to the boiler in 1828, *was* afterwards lengthened, and its height *is* now about twenty feet.—Com. Pub.

With regard to the means of preventing explosions, I think no new invention necessary unless it be some plan to prevent persons from meddling with what they do not understand; for if a steam engine is properly made, the boilers furnished with safety *valves* of sufficient dimensions, and weighted to rise when the pressure of steam is four pounds per inch, there can be no more danger in using it than in using any other machinery of equal magnitude. But to insure the proper construction and management of them some legal restraints must be imposed. And I see no reason why the man who builds steam engines for *passage boats*, and he also who manages them, should be exempt, any more than a physician or a lawyer, from giving good evidence, to competent judges, that they understand their business, and some pledge that they will make a right use of their knowledge.

Method of Tinning Cast Iron, &c. *By* ISAIAH LUKENS.

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

GENTLEMEN,—Having frequently tried the following process for *tinning cast iron*, and having found it very easy of execution, and certain in its operation, I am induced to offer it for the benefit of those of your readers who may have occasion to use some process to effect the same purpose. This method is applicable to all sizes of castings.

The surface of the casting is first to be made perfectly clean, by turning, or scraping away the outside. Filing does not answer as well as turning or scraping.

Make an amalgam of tin with mercury, containing enough tin to form a soft solid, say of the consistence of butter at 60°.

Prepare a dilute solution of muriatic acid; the muriatic acid of the shops diluted with about an equal weight of water, will give an acid of convenient strength.

Heat the casting until so warm that on a further addition of heat it could not be held conveniently in the hand. Dip a clean linen rag into the dilute acid, and wash with it the surface of the casting where it is to be tinned. Upon another piece of clean linen take up some of the amalgam, and pass it over the surface which has been wet by the acid.

A portion of the amalgam adheres; by rubbing the tin is precipitated upon the surface of the iron to which it is united, and the surface is tinned; after which the article should be immersed in a bath of melted tin and rosin to perfect the coating.

The explanation I take to be this. The diluted acid, aided by heat, acts upon the casting, forming a chloride of iron; when the amalgam is presented to this, the chlorine leaves the iron to combine with the mercury, and the iron and tin are precipitated in very intimate union if not in chemical combination. I do not mean to lay particular stress upon this explanation, the steps of the process are detailed just as I have frequently taken them.

It may not be amiss while writing to give an illustration of a method of making available for purposes of art the polish which nature presents in some melted solids. The polish of a clean surface of an alloy of melted tin and lead is very beautiful. Suppose it be desired to fix this upon a tube of copper or iron, as upon the iron spouts attached to tea kettles of tin. The tube is, if of copper, to be prepared in the usual way, and, if of iron, to be well tinned by the method just given, (or any equivalent one.)

Dip the tube into a vessel of a melted alloy of tin and lead, and allow it to remain until thoroughly heated. On withdrawing the tube the liquid metal runs down the surface. Pour rapidly *into* the tube cold water. The metal will immediately fix upon the outer surface, retaining the polish which it had when liquid.

Yours, &c.

Isaiah Lukens.

FRANKLIN INSTITUTE.

Note of the Committee on Explosions, acknowledging the receipt of a communication from John S. Williams, of Cincinnati, Ohio.

The committee on explosions acknowledge the receipt of the letter from Mr. Jno. S. Williams, requesting their consideration of a paper containing "some propositions and suggestions on the means of obviating or lessening the accidents incident to steam navigation," and inserted in the Journal of the Franklin Institute, vol. viii. p. 289. The typographical errors named will be corrected.

Explosions of Steam Boilers.

[Continued from p. 9.]

Supplement to the Communication of Thomas Ewbank, *to the Committee on Explosions.*

New York, June 23, 1832.

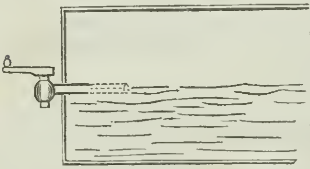
Gentlemen,—I take the liberty to submit the following remarks as supplementary to my second communication.* Want of time prevented me from including them in my last. It was my intention to test these, as well as certain other devices, by experiment, previous to troubling you with them, but other engagements have hitherto prevented the accomplishment of that purpose.

First, in relation to gauge cocks as indicators of the level of the water within a boiler.

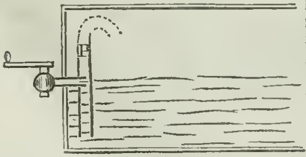
The inaccuracy of the common gauge cock as a means of detecting the true height of the water in a boiler, arises chiefly from two causes: firstly, from the agitation of the water while steam is being withdrawn from the boiler to supply the engine, or through the safety valve: and secondly, from the current, or rush of steam, produced towards the aperture of a gauge cock when it is open; in consequence of which, the water, though previously at rest, and below the opening, is agitated and carried out through it.

These defects are illustrated by Mr. Peale, in the eighth volume of the Journal of the Institute, page 147.

The last mentioned defect may be lessened by a perforated tube, five or six inches long, (see the accompanying cut,) attached to the end of the cock which is within the boiler. Such a tube would prevent the current from being concentrated towards the aperture of the cock, as the steam would enter it through the small openings in various directions. The small holes would, however, be liable to be filled up by dirt, &c. which so frequently chokes the common cock.



The next figure shows a method by which both the defects to which I have alluded as affecting the gauge cock, may be remedied.



The cock passes through the head of the boiler in the usual way, and is then united to a perpendicular pipe P, open at both ends, and about two or three inches in diameter. The lower end of the pipe is four or five inches below the surface of the water, and its upper end is carried as far above that level as may be convenient. This end may also be turned over, as represented by the dotted line, to prevent dirt, &c. from being thrown into it by the agitation of the water. When this cock is opened no current can be formed in the direction of its aperture, and the water in the tube P, (which will of course be at the general level of the water in the boiler,) will not be so subject to agitation. This cock will, moreover, not be so liable to be choaked as the common one.

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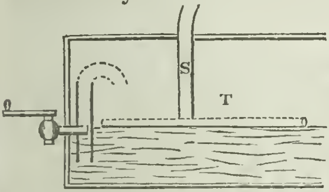
* Journal of Franklin Institute, page 1, vol. x.

It would appear that as the agitation of water in a boiler is caused by withdrawing the steam from it, this agitation might in some measure be prevented by a different mode of adapting the steam pipe to the boiler.

If the pipe could be so adapted as to allow the steam to press down towards the surface of the water, when entering the pipe, instead of (as in the usual way) ascending from the water, then the steam would have the same tendency to preserve the water at rest, which, by the present mode, it has to agitate it. The annexed figure will serve to illustrate my idea.

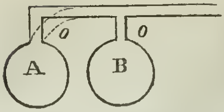


Suppose the steam pipe S to descend into the boiler until within two or three inches of the surface of the water, and then to be connected to the horizontal pipe T, which is perforated with small holes on its upper side only. The steam, as it enters this pipe, would have a direct tendency to preserve the water from rising, because the direction of the pressure would be then opposed to it. It may, perhaps, be supposed that in consequence of the position of the pipe with respect to the water, a portion of water will escape through the pipe with the steam, but if the steam in entering the pipe prevents the water from rising, I do not see how such an effect can be produced; and from the observations which I have made on the use of the float, (described in my last communication,) which in its first modification was liable to the same objection, I am inclined to believe that in this case there will be no such difficulty, and that the effect supposed can only take place by the careening of the boat, &c. Were the openings made in the lower side of the horizontal pipe, then, probably, as much water as steam would pass through them.

This mode of perforating on the top is applied to the gauge cock in the same figure, its end being closed, and the opening made on its upper side. This appears to me to be preferable to the usual opening in the end, as a less decrease of water will be detected by it. Besides, I do not see how the water (if previously below the opening,) can rise into it when the cock is opened for a short, or indeed for any, length of time, as is the case in the common gauge cock. (See Mr. Peale's account before referred to.)

Second, in relation to the steam pipes of connected boilers.

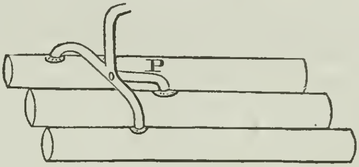
The method of connecting steam pipes to boilers, where more than one is used, is frequently the cause of a more rapid consumption of water in one boiler than in another; and affords a further reason for feeding each boiler with water separately. Some boilers have their



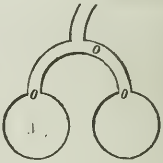
steam pipes, (as in the cut,) connected to them at right angles: the consequence of this is that more steam escapes from B than from A when B is nearer the cylinder of the engine, and the steam has the same facility of escape from it as from A. Others, again, have the pipe from A curved, as represented by the dotted lines, and by this mode more steam is consumed from A than from B.

The proper mode would appear to be, to make the tubes *o*, *o*, of the same length, curvature, and diameter, before terminating in the steam pipe, as in the annexed figure, C. Where more than two connected boilers are used, the tubes should be arranged as shown in the figure D. The branch P, from the centre boiler, should be placed so far back of its junction with the others, as to make its length equal to that of each of these.

D



C



These remarks may very possibly be of little or no value, but as they are the result of observations made at different times, I have thought it right to submit them, with all their imperfections, to the enlightened judgment of the committee.

Very respectfully,
Thomas Ewbank.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN FEBRUARY, 1832.

With Remarks and Exemplifications, by the Editor.

1. For a machine for *Washing and separating Gold from earthy matters;* Thomas Rives, Hall county, Georgia, February 3.

This machine operates upon the principle most commonly adopted in similar structures, presenting little novelty that we perceive, excepting in its being the first patent for a gold washing machine from Georgia, whilst all the other states through which the gold region extends, have previously sent their contributions to the patent office.

A long trough is to be made something like a horse trough, and this is to have bars of iron across it, which whilst they allow the finer particles of matter to pass between them, keep back the coarser. The earth to be washed is put into this trough, and water from a stream admitted at one end of it, by which the gold and other matter washed out, falls into a second trough standing at the other end. This second trough has three or four partitions dividing it into separate compartments, which have agitators in the form of rakes, moving in them. The washings run through these several compartments, there being notches in the upper edges of the partitions for that purpose. The washing is further continued by putting the part containing the gold into another trough, suspended by ropes, having also a stream of water running into it, and being kept in constant agitation. A small water wheel, or any other adequate power, is employed to give motion to the respective parts.

The whole apparatus we think belongs to the infancy of the art, being but little calculated to save the finer particles of gold; a defect common to most of the machines which have been patented for the same purpose.

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2. For a *Cheese Press;* John Holmes, Paris, Oxford county, Maine, February 6.

This is quite an old fashioned press, its action being dependent upon two eccentric wheels. There is a frame made with cheeks in the usual form. A shaft, hung on pivots, crosses the upper part of this frame, from cheek to cheek; upon this shaft there are two eccentric wheels, and upon the upper side of the follower two friction wheels, or rollers, upon which the eccentrics have their bearing. For the purpose of making continued pressure, weights may be hung upon a lever extending from a hole in the shaft carrying the eccentric wheels.

There is no claim made, nor indeed does the specification contain a description of the machine, dependence being placed upon the drawing only, which gives a full view of the instrument.

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3. For an improvement in the mode of managing heat for warming rooms, called the *Fuel Saver and Economical House Warmer;* Robert B. Varden, city of Baltimore, February 6.

There are so many things in the plan here described which have been heretofore applied, and some of them patented, that we cannot tell precisely what is intended to be claimed as new, the patentee having presented the whole, and then informed us that what he claims "is the before described mode of managing heat, by which rooms are warmed, and cooking performed from the caloric that usually escapes with the smoke through the flue of the chimney."

The fire place is to be of cast iron, made in one piece, and set into the brick work so as to leave a hollow space behind the back and jambs. Into this hollow space air is to be admitted from the cellar, or from out of doors, whence, being heated by the fire, it is to pass through proper openings into the room. Above the fire place a hollow cylinder of iron is to cross the flue: cold air is to be admitted into this also, and in like manner, when warmed, is to escape into the room. Brass or other tubes are likewise to conduct heated air from chambers under the hearth, and into a room above.

The apparatus denominated the economical warmer operates in the manner of the drum attached to stove pipes, and is to be fixed in an upper apartment, against the flue of the chimney. When it is used, a damper is made to close the flue, and cause the smoke and heated air to pass into, and through the warmer, which may be made of sheet metal, in any form, having cross tubes opening into the room to expose a larger surface to the heating process. A damper in the flue, or in the pipe above it, which returns into the chimney, serves to regulate the draft.

Besides the opening from the cellar admitting air behind the jambs, &c. there is another through the middle of the hearth, to supply a draft to the fire. Several appendages which we have not noticed are mentioned and figured; but the general plan has been described, and we leave it to those who have given attention to the different apparatus which have been devised for economising heat, to discover what there is of novelty in the principle, or in the arrangement of the foregoing *invention.*

4. For an improvement in the method of *Setting the teeth of Mill Saws;* Norman Urquhart, Madison county, Alabama, February 7.

The two lower teeth of a mill saw are to be set "one-quarter of an inch wide, and three-eighths of an inch from the edge of the tooth in towards the blade." When this has been done, a tooth is to be marked, the distance of which from the bottom of the saw is equal to four times the length of the crank; neither this tooth nor any of those above it are to be set, but the teeth between this and the lower teeth are to be set so that their points will just touch a straight edge laid on each side of the saw, from the marked to the wide set tooth at bottom. The set of the teeth will thus decrease regularly in width from the bottom to the marked or unset tooth.

The patentee says that when thus set a saw will cut with increased speed and power, whilst it will run perfectly free from all side friction.

5. For an improvement in the *Duster for cleaning Rags;* George Camel, Manchester, Hartford county, Connecticut, February 7.

The machine upon which this is an improvement was patented on the 27th of July, 1831, and is described in vol. ix. p. 60. The improvement "consists in surrounding the shaft of the duster for cleaning rags with a drum, and giving the drum and shaft a more rapid motion than the screen, so that the rags may be more easily cleaned." The instruction given for regulating this motion is so to apply the power, that whilst the shaft turns about seventy-five times in a minute, the duster shall turn about thirty-seven times, and both in the same direction.

6. For an improved *Tobacco Press;* George Booker, Richmond, Virginia, February 8.

The frame and screw of this press resemble, generally, those in common use, but the seat, or bed, upon which the keg, or box, is placed, instead of being firmly fixed to the cheeks of the frame, has two strong gudgeons passing through holes in the cheeks, and consequently admitting of its being inclined forward or backward. In pressing tobacco into kegs or boxes as heretofore practiced, much inconvenience has been experienced from their liability to burst in consequence of the great pressure, and the inadequate means pursued of bracing or supporting them. The principal part of the present invention consists of an apparatus for avoiding this difficulty. A cast iron case is made, of suitable form and size for containing the box, or keg. This iron case is made to open by a proper hinge joint, and has contrivances for holding it securely together. Plates of metal fill up the space which may exist between the keg or box and the cast iron case, and these are forced up by screws working through the latter, whilst the whole is so contrived as to be at once seated centrically under the screw, and thus to insure the regular action of the press. The turning of the bed piece facilitates the placing, removal, or examination of the article under pressure.

The whole apparatus is clearly described, well represented, and will certainly answer the purpose intended.

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7. For a *Churn;* Jonathan H. Bruner, M'Kean, Licking county, Ohio, February 9.

We have had a truce with churns for some time past, and regret that in again introducing one to our readers, we are compelled to say that the character of novelty which is claimed for it, cannot be sustained. The body is that of the common vertical churn; it has a vertical shaft with pins, or dashers, projecting from it, which, as they revolve, pass between other pins, or dashers, projecting from the sides within the churn.

The shaft has a pinion on its upper end which is acted upon by a crown wheel, turned by means of its horizontal shaft and crank. The dashers, and the mode of operating, are perfectly familiar.

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8. For a *Pump,* called by the patentees "a labour saving rotary gate purchase;" Levi B. Gitchell and Joseph Musser, Canton, Stark county, Ohio, February 11.

Although this contrivance is called labour saving, it is certainly one of those to which we might resort if we desired to gear a pump in such a way as would prevent its working with too much ease. It is proposed to use two barrels, constructed in the usual way; the *novelty* consisting in an old and long exploded mode of working the pistons. This is to be effected by means of a double rack and pinion acting upon each rod, and made in the way so frequently proposed for getting rid of the crank motion in the steam engine. There is a vertical frame having teeth upon each of its inner sides, and into these teeth, the leaves of a pinion are to take, the frame shifting from side to side as the piston is to be raised or lowered. There being two pistons, there must be two such frames, and two pinions on the horizontal shaft by which they are to be worked.

In order *to increase the power*, a pinion, turned by a crank, gears into a cog wheel on the end of the shaft, and we are told that in this way the power may be increased in any degree; but it seems to be altogether forgotten that the friction is also increased, and the velocity diminished in the same proportion. The patentees seem to consider the whole apparatus as new, they having described it in all its parts, without making any claim.

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9. For an improvement in the *Construction of the Dry Dock;* David Brown, city of New York, February 11.

A particular description is given of this dry dock, without any designation of those parts which are considered as new. As the patentee is a practical ship builder, he is undoubtedly aware of what has been heretofore done in this species of naval architecture, though not of the requirements of the patent law, which direct the patentee to distinguish his invention from every thing which has been before known or used.

This dry dock is to be built of timber, and is to be fastened between two piers, and sunk down so that its top shall be above the highest tides. A steam, or other engine, is to be used to free it from water. Its sides are to flare out about four inches to a foot, and there are to be diagonal braces within, from the bottom to the sides, which are to be so planked as to form steps, serving the purposes of the workmen, and lessening the capacity of the dock for containing water. The gates which enclose the vessel are to be about twenty-three feet from the outer end of the dock. The object of placing them there is to have double gates, one pair being near the end, that they may be closed whenever the inner or main gates required to be repaired.

The patentee designates the number and size of the main timbers to be used, and with this kind of description closes his specification; in these particulars we do not think it necessary to follow him, there not being any thing special, or peculiar, excepting what we have given above. The general plan is certainly not new, although the patentee could undoubtedly have pointed out many parts which are so.

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10. For a *Washing Machine;* Silvanus Hathaway, Massillon, Stark county, Ohio, February 13.

The claim of the patentee will afford a tolerable idea of the nature of this invention; it is as follows:

"What I claim as my invention, and for which I ask a patent, is the general plan and arrangement of the machine as described, namely, the placing of a shaft horizontally, which shaft is to be turned by a crank, and has on it a fluted roller, which, by its revolution, causes a circular tub, or trough, to revolve upon its vertical axis. The bottom of said tub, or trough, being also fluted and elevated towards the centre so as to adapt it to the conical roller. I also claim the employment of a spiral spring, or of a weight, acting upon the outer end of the horizontal shaft to press it and its roller down, and at the same time to admit of its rising according to the varying thickness of the clothes between the two surfaces."

The only washing machine which bears any strong resemblance to this is one patented by John Hall, April 20, 1831, and described vol. viii. p. 163.

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11. For an improvement in the *Machine for Pressing Flour, &c.;* Silvanus Hathaway, Massillon, Stark county, Ohio, February 13.

In this press the lever which forces down the follower upon the flour, is raised by means of an endless screw, working against the end of its longer arm. The concave nut in which the screw works does not embrace it, but is a segment of a female screw, so fixed that it can be thrown out of gear when the lever is raised to the required height. The claim is "to the employment of an endless screw upon a vertical shaft, which, by its revolution, raises the piece containing the segment of a female screw, and thus operates upon the packing lever in the way described; and to the manner of disengaging the said piece when required."

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12. For a *Machine for Dressing or Picking Stone or Marble;* Clark Miller, jr., Williamsport, Lycoming county, Pennsylvania, February 14.

This machine is furnished with two or more picks, or chisels, which are placed on the end of a lever, hung like those of a tilt hammer, and like them raised by cams, or wipers. Springs are made to bear upon the levers, near to the picks, in order to quicken the blow. The whole machinery is fixed on a frame by which the operating parts can be shifted about. There is no claim.

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13. For a process for *Bleaching Bay-berry Wax, or Bayberry Tallow;* Benjamin Gomperts, city of New York, February 14.

Five hundred pounds of the wax, melted, are to have added to them a solution of chloride of lime, consisting of three hundred pounds of the chloride, and three hundred gallons of water. The whole is to be kept heated, and stirred until the wax is nearly white. A mixture of nine pounds of vitriol, and six quarts of water, is then poured in, which, it is said, serves to separate the water from the wax; the latter is then to be dipped off. The same process is to be repeated, after which five gallons of salt are to be added, and this, we are told, completes the separation of the water from the wax.

It appears to us that if the bleaching of this wax cannot be effected by a more economical process than the foregoing, it will be found too expensive to come into general use.

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14. For a mode of *Fastening Handles on Hoes*, Shovels,

Axes, Hammers, &c. &c.; Reneer Dare, Greenwich, Cumberland county, New Jersey, February 14.

The hoe, or other tool, furnished with an eye, is to be passed on to the handle in the usual way. A piece of iron is to be forged with a shank and head, and to have a mortise through its shank to receive a key; the head is to be larger than the eye in the hoe, or other tool. The shank of this nail, or bolt, is to be let into the handle, so that the head of it may bear against the eye of the tool; a key is to be passed through a mortise in the handle and that in the inner end of the bolt, which thus confines the tool in its place. There must be a ferule driven on to the handle, reaching from the hoe to the mortise hole that the key may bear against it.

Did the patentee never see pitch forks fastened into handles by a key through a mortise in the shank and handle, a ferule being first driven on to the latter? This, it is true, makes but one half of his invention, there being no broad head required.

15. For a *Washing Machine;* William M'All, Hiram H. Higgins, and Reuben G. Rodgers; Athens, Limestone county, Alabama, February 15.

A trough with rollers on the bottom, forming together a hollow segment of a circle, has a convex segment formed of slats, suspended upon a spring above it, and between these two parts the clothes are to be rubbed until clean. After being washed they are to be passed between two wooden rollers, fourteen inches long and six in diameter; these are to squeeze out the water, and obviate the necessity of wringing. That the goodness of this invention may be known, the patentees shall speak for themselves; they say, "The foregoing described machine differs from all others in this, that the lower segment contains rollers and is stationary, the upper segment contains slats and is suspended from a spring. The spring is new, and also the cylinder press." But for the above assurance we should have doubted the novelty of some of the parts pointed out, and we still apprehend that the patentees have not seen the whole of the one hundred and fifty washing machines which have been patented in the United States, to say nothing of those in other countries.

16. For a *Shingle Sawing Machine;* Duncan M'Arthur and Thomas M'Kibbin, Urbanna, Champaign county, Ohio, February 15.

The general arrangement of this shingle machine resembles that of some others. The block is to be placed upon a carriage which is moved up to a circular saw by a rack and pinion. There is an apparatus for canting the block to give the shingles their proper slope. The parts designated as new are those by which particular movements are made, and these would require the drawings for their explanation, which, although they appear to be very well conceived, we do not think it necessary to give, as others equally good could be readily contrived by any skilful mechanician.

17. For an improvement in the *Still;* Jacob Miller, Lancaster township, Lancaster county, Pennsylvania, February 16.

This improvement consists in a particular arrangement of the head of the still, within which ascends a pipe or tube, about ten inches in diameter, up which the vapour is to pass; this tube reaches to about two thirds of the height of the head, it is covered with a cap, between which and the outside of the tube there is a space, through which the steam that rises is turned again downwards into the liquid, into which the open end of the cap dips to the depth of about two inches. A small supply tube passes up through the head, and near to one side of it; its lower end dips into the liquid, and through this last tube a fresh supply of low wines may be poured in, and the tube is then to be corked up.

There is no claim made.

18. For an improvement in the *Percussion Gun Lock;* Israel J. Richardson, Palmyra, Wayne county, New York, February 17.

The specification of this patent covers upwards of twelve pages, and enters into a very minute description of the various parts of the lock, but a small portion of which, however, is shown in the drawing. An attempt is made to be minutely particular, but the writer has certainly 'darkened council with words,' without communicating knowledge. In this lock, percussion powder is to be used, as formerly, without caps, and there is some peculiarity in the mode of making the discharge. The chamber in which the powder is contained, is a box standing on the upper edge of the lock plate, and may be about one and a quarter inch in length. It is perforated from end to end, and two pins fit into these perforations, one passing in at each end. When the gun is to be discharged, these pieces are forced simultaneously in, and meet at the middle of the perforation, where they inflame the powder. One of them is forced in by a cock placed in the usual manner, and there is another lever, or cock, at the opposite end of the plate, to force in the other pin. A rod, or stirrup, extends from one of these cocks to the other, causing them to act simultaneously.

The patentee claims all the advantages arising from the use of a gun lock constructed on the principle specified by him, and the various modes of action which he has intended to describe; we apprehend, however, that he has not succeeded in giving such a description as shall enable a workman to understand his principle, or reduce it to practice.

It will not be expected that we should give an opinion of the goodness of an invention which we have confessed we do not understand; this lock may be superior to others now in use, but we see nothing to warrant the conclusion that it is so.

19. For an improvement in the *Mode of manufacturing Oil Cloths by machinery;* Deborah Powers, relict and administra-

trix of the inventor, William Powers, Lansingburg, Rensellaer county, New York, February 18.

The petition for this patent states that the petitioner has reason to believe that some person has surreptitiously obtained, or is about to obtain, letters patent for the machinery invented by her late husband; alluding probably to the patent granted to Otis Ferrin, of Lansingburg, and noticed at p. 323 of our last volume. The machinery here described is essentially the same with that of Mr. Ferrin, with the exception of the hopper, or trough, for containing the paint, which is not mentioned in the present patent, but it is stated that the size, oil, paint, or other material, to be spread upon the cloth, is to be poured upon it whilst stretched, and lying horizontally, and that as it is drawn through the machine, the gauge plate, or scraper, removes the superfluous material; and, in the course of from five to ten minutes, will leave a perfectly uniform covering upon a piece of cloth four yards in width, and thirty in length.

We hope that Mr. Ferrin has property enough to carry on his business to advantage by means of his machine, if he is the true and original inventor of it; or, if otherwise, to pay threefold damages to the fatherless children and the widow, if he has attempted to wrong them.

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20. For an improvement in the mode of *Cutting out Visors of Leather, and other materials, for Caps and Hats;* John Hoskins, Roxbury, Norfolk county, Massachusetts, February 20.

The apparatus described in the specification of this patent is, in its general features, similar to that noticed at p. 43 of our last volume, as patented by George Demitt, on the 20th of July, 1831. This patent is referred to in the specification, and the cutter used by Demitt is spoken of as a thing long known and used. The present patentee claims only to have made an improvement on that apparatus, by which the stamping, or embossing, of a pattern upon the edge of the visor is effected at the same time with the cutting. For this purpose a stamping tool, properly engraved, is fixed within the cutter, fitting close up to it, and standing sufficiently back from the cutting edge to allow the operation to be completed. This stamping apparatus is made adjustable to adapt it to leather of different thicknesses.

The claim is to that construction of the apparatus which enables it to cut, stamp, and deliver the visor at one operation.

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21. For an improvement in the mode of constructing the *Steam Engine;* Stacy Costil, city of Philadelphia, February 20.

The cylinder of this engine is to vibrate on trunnions at its centre, and the piston rod is to be passed through a stuffing box at each of its ends. There are openings for the admission and discharge of steam, at each end of the cylinder, and faced plates forming the valve seats, which are in the same vertical plane with a cross section of one of the trunnions. There are no steam ways cast on the cylinder, the steam being let on and off directly through these openings on the faced plate. The stationary valve against which the faced plates vibrate, is a flat hoop, concentric with the trunnions, and sufficiently large in diameter to extend from end to end of the cylinder, and to cover the valve seats. This flat hoop is cast hollow, for steam ways, each hollow forming nearly a semicircle, but with stops between them to prevent their communicating with each other. On that face of the hoop which fits on to the fore plates there are four openings, two to each face plate, serving to let the steam on and off at each vibration. Steam, and eduction pipes, enter at the other, or outer side, of the hoop. This hoop is held up against the valve seats by a bar of iron which crosses it, and which is borne up by a screw. The claim is to the "holding the valve against the cylinder by mechanical power, the valve being stationary, the disuse of the steam chest, and the consequent simplicity of the whole arrangement."

There is no small resemblance between the action of this valve and that described by Mr. Halloway at p. 43, under the name of the wing gudgeon valve. In that, the openings are near to the trunnions, in this, the fore valve is extended so as to carry the openings to the ends of the cylinder: and what is a little singular, both these patentees make one of their claims to consist in "the simplicity of the whole," which simplicity is rather an unpatentable article.

22. For an improvement in the *Machine for weighing heavy bodies;* Erastus and Thaddeus Fairbanks, St. Johnsbury, Caledonia county, Vermont, February 21.

The patent above alluded to is taken for an improvement on the weighing machine patented by the same gentlemen on the 13th of June, 1831. In speaking of that machine we observed that the general principle upon which it operated was the same with those which have been many years in use in England, and also in this country. There was some difference in the arrangement of the levers upon which the platform rests, and the patentees have since improved that arrangement, and made it the subject of a new patent.

Articles of this description require engravings for their illustration, there being but few persons who would clearly comprehend a mere verbal description.

23. For a *Fanning Mill for cleaning Grain;* Peter Prine and Lott Huestis, Auburn, Cayuga county, New York, February 23.

This fanning mill has the usual appendages of such machines, and it would be difficult to tell in what it differs from some of those which have been already patented; this difficulty seems to have been felt by the patentees as well as by ourselves, for they have neglected to say any thing upon the point, and the instrument looks so much like its predecessors, as to lay no visible claim to originality. We suppose, however, that as there are two patentees, there must be at least two points of novelty.

24. For a *Portable Horse Power;* James K. Cory, Bethel, Clark county, Ohio, February 27.

We do not know why this is called a portable horse power, as it is not made locomotive. In its construction there is little, if any, novelty, it being the common mill in which a horse by walking round turns a vertical shaft, carrying a horizontal cog wheel. There are ratchet wheels to prevent a sudden check, by the stopping, or backing, of the horse; particular directions are also given relative to the size of the respective parts, and the materials of which they should be made. There being no claim, we are not aware of the points upon which the patentee relies to sustain his exclusive right, and we do not perceive any part which we should not feel free to use without thinking of interfering with the invention of any one living.

25. For a *Cane Rifle;* being an improvement on rifles and guns; Roger Newton Lambert, Repton, Worcester county, Massachusetts, February 27.

Our readers are aware that guns, or rifles, in canes, are not new, but of course ingenuity may devise many novel modes of arranging the parts of such an instrument; that before us exhibits much skill, but still we think the instrument itself, however made, will never supersede the sportsman's gun, or rifle; and that for defence and offence, but few need it, and but few, therefore, ought to carry it. A truce, however, with moralizing; this belongs not to our present office, which is to tell how things are made, and not to assign moral reasons why they ought not to be used. As in many other cases, however, we cannot readily describe the peculiar arrangements of this cane rifle, although one point may be noticed which will be easily comprehended. The head of the cane draws back, so as to expose the lock, and then bends down upon a joint, assuming a form something like the butt of a gunstock. This is claimed, as is also the sliding of the barrel within the cane, for the purpose of retaining a cap over the muzzle, and the motion by which the cap, at the ferule end, is thrown off, when the piece is to be discharged.

26. For a *Card to be used in manufacturing Water Proof Hats,* Richard Mills, city of Baltimore, February 27.

This invention is described as a felting formed in the usual way, and then stiffened with a composition consisting of "the whites of hen's, geese, turkey's, duck's, and Guinea fowl's eggs, mixed with oyster shell and stone lime, being composed of half of each." This felt then becomes the foundation for a card, to form which it is stuck with teeth, and nailed upon a board. We are told that it is then called a "hot-water-proof-raising-card, used in the manufacture of water proof hats."

There is certainly something rather queer in this description; the eggs of so many different fowls, and two different kinds of lime are prescribed; perhaps the patentee knows the *why,* although he has not given the *because* to us. Should the Guinea fowl's eggs be omitted, will the cookery be spoiled? and if not, would the rights of the patentee be infringed by using a composition without it?

27. For a *Compound Lever Balance;* Jared B. Wetmore, Rush, Monroe county, New York, February 27.

The instrument here patented is merely two combined steelyards; the specification does not even describe them, but descants upon the great power and utility of such an apparatus. Were it not for the drawing, therefore, we should have had but little idea of the form of this *very new* and useful machine. It is not the first time that we have called the attention of our readers to a patent for combined steelyards, and judging by the general course of things, it will not be the last, unless our career should prove to be a very brief one. The patentee has not claimed the particular arrangement of the instrument exhibited by him in his drawing; and where there is nothing new in the principle of, or the mode of action, in a machine, any claim made must be to some special, or particular, novelty of arrangement.

28. For an improvement in the *Bark Machine;* James T. Gifford, Veteran, Tioga county, New York, February 27.

This machine is intended to cut bark instead of grinding it as is usually done. There is a circular cast iron plate, of suitable diameter, the surfaces of which are flat. In its centre a spindle is fixed, as this plate is the runner. Six or more slits, or openings, are made through this plate, extending from within two or three inches of its periphery towards the centre. Knives, or cutters, are fixed in the slits, and project above the surface of the plate, in a degree proportioned to the intended fineness of the bark, which as it is cut is to pass through the slots in which the knives are contained. This plate is to be placed within a suitable frame, with the lower end of the spindle resting on a step, and what the patentee calls a bar circle is placed immediately above the runner, so close as just to allow the knives to revolve under it. The bar circle has an appearance something like the framing of a circular window, forming a lattice work of cast iron, the outer rim of which is of the diameter of the runner; it has a small inner circle forming an eye, through which the spindle passes. A third circle, intermediate between the rim and the eye, but nearest to the latter, is also used; bars radiating from the centre, in the manner of spokes, join these several rims together, and serve as stops for the bark, against which the knives cut.

A tub, which forms the hopper, surrounds the whole; there are radiating partitions in this tub, corresponding with the bars of the bar circle, and these may be considered as a series of hoppers, which, in the drawing, amount to twelve in number.

The operation of the machine will be readily understood. There is no claim made, the whole arrangement probably being considered as specifically different from the cutting and grinding machines heretofore made.

29. For an improvement in the *Head Blocks of Saw Mills;* John Sinclair, Richland, Belmont county, Ohio, February 28.

(See specification.)

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30. For an improvement in the *Plough;* Samuel Ogle, Fredericktown, Frederick county, Maryland. Patent issued to his assignee Samuel Witherow, Gettysburg, Adams county, Pennsylvania, February 28.

This is said to be an improvement on the plough for which a patent was granted to said Ogle on the 9th of June, 1818. This patent was for using an iron landside with the cast iron mouldboard, which was cast separately, but attached to the mouldboard by screws, or otherwise. The improvement now claimed is the casting of the landside of greater height than formerly, at its fore part, so that it may reach, or enter into, the beam. This part is to be made sharp, to answer as a substitute for the common coulter.

There is a good drawing of the plough, but no written references, as required by law. Cast iron landsides are described in several patents; some in one piece with the mouldboard, and others attached by screws. The claimants, direct and indirect, to cast iron mouldboards and landsides are so numerous, that should the whole of them become entangled in litigation, their ploughs would prepare a fine harvest for the lawyers, whatever might be the case with the farmer.

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31. For a *Windlass* for hoisting and lowering heavy weights, which the patentee denominates a " Winch and Gin; Ebenezer Allen, city of New York, February 29.

That this windlass is a very good one there is no room whatever to doubt. We cannot, however, go the whole length with the patentee, who avers that " by means of this apparatus, four men can hoist three tons weight; and three men can hoist more in less time than twelve men could do by any other method heretofore used."

We have said that this is a good machine, but those who have arrived at years of discretion have lived to little purpose if they have not learned that goodness and novelty are very distinct things; and indeed that whilst the latter lasts, the existence of the former may be too readily admitted. This machine, however, will not, in our opinion, be liable to any suspicion in consequence of its novelty; for under various forms, combinations, and modifications, it has had the test of long experience, and has fairly won its honours. This *winch and gin,* or *portable winch,* is in form and substance the common hoisting windlass, used for raising stones and other heavy bodies. A square frame is made which is the bed, or ground sill, of the machine; and from opposite sides of this, two uprights rise which are to support the axles, drums, or barrels, with the necessary wheels and pinions upon them, the gudgeons of which run in bearings in these uprights. In raising goods, a winch attached to the upper drum or barrel, is to be turned, and a pinion upon this takes into a wheel on the end of a second drum or barrel; to either of these a rope or chain may be applied for attaching the goods, and if still greater power is wanted, another barrel, and an extra wheel and pinion, may be employed.

When the goods are to be lowered, this is to be done with the common brake, an instrument known to every competent mechanist. This brake the patentee calls *a spring or friction band*, and describes it as a hoop of iron passing loosely round a cast iron wheel, and capable of being made to press forcibly thereon by means of a lever. When the machine is to be used for articles of enormous weight, a second brake is to be fixed upon another barrel.

We almost fear to copy the final averment and claim of the patentee, as where there are antipodes there must be a whole world between them. He says "this machine, and all its parts, and every method of using it as hereinbefore described, the subscriber and inventor claims as his invention, and he has had the satisfaction of seeing it practically tested and approved on board of many vessels sailing out of the ports of the United States, he accordingly hereunto subscribes his name."

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a patent for an improvement in the head blocks of saw mills. Granted to JOHN SINCLAIR, *Richland*, *Belmont county*, *Ohio*, *February* 28, 1832.

To all whom it may concern, be it known, that I, John Sinclair, of Richland, in the county of Belmont, and state of Ohio, have made certain improvements in the head blocks of the ordinary saw mill, by which the log to be sawed is held, shifted, and gauged, and the boards delivered in a more advantageous way than has been hitherto done; and that the following is a full and exact description of my said invention, reference being had to a drawing deposited in the patent office, and making part of this specification.

The apparatus which I employ is to be fixed upon each of the head blocks, to hold and adjust each end of the log to be sawed; the description of that upon one, therefore, will serve equally well for the other.

The log is to be held down by a lever pressing upon its upper side, the long end of the lever projecting out behind the head blocks, and its short end holding the log. There is a plate, generally of iron, fixed upon the head block to serve as a support to the fulcrum of the lever, and as a ratchet to retain a pall by which the lever is held in its place. This plate is fastened to the head block, by screws, or otherwise, its plane is parallel to that of the saw, and it may stand about an inch from the centre of the block. Its height will be regulated by the height of the largest log to be sawed.

Near the inner edge, the plate is perforated with holes one above the other, through which the pin, serving as a fulcrum to the lever, is to pass, these holes allow the lever to be shifted to suit the height of the log. The lever has a long slot, or mortise, to admit the plate to pass through it. The outer edge of the plate is notched in the manner of saw teeth, and forms the ratchet, before named. A pall, or catch, attached to the lever, falls into these notches. When the long end of the lever is raised, its short end holds the log firmly, the pall sustaining it in its place.

To gauge the thickness of the stuff, and also to keep the log in its vertical position, its face, after being slabbed, is forced up against two vertical cheeks, standing at such distance from the saw as the thickness of the stuff may require. These cheeks are fixed upon pieces which slide upon the head blocks, to admit of their being removed to any distance required. I usually fix them to fall back exactly in the manner of the dog which works on hinges, or joints, but in some cases this is unnecessary.

The log, as the boards are cut off, is to be forced up against these faces, and held there by means of a progressive, or travelling lever, contrived for that purpose. A bar of iron is to be bent in the middle, staple fashion, so that the two parts of the bar shall stand parallel to each other, and allow a space, say of one inch, more or less, between them. This, when bent, may be a little longer than half the length of the head block, but must be short enough to pass within the saw frame. Instead of one bar bent, it may consist of two bars, properly secured, so as to answer the same purpose. It is to be fixed upon the head block, one of the bars lying thereon and being secured thereto; its two ends butt against, or may be rivetted to, the plate which supports the first named lever. In the slot between these two bars the progressive or travelling lever works, generally about six inches above the bed of the log. The upper edge of the lower bar is notched to act as a ratchet into which the catches of the progressive lever are to fall. This last lever passes between the two bars; it is furnished with two palls or catches, which fall successively into the notches upon the bar, and cause it, when worked, to follow the log, its short or inner end bearing against the side thereof. The mode in which this is effected will be rendered obvious by the drawing before referred to.

As the boards are to be sawed completely off, the log will become too light to hold the moveable head block down, it is secured, therefore, to the carriage by bolts which pass through it, hook under the carriage, and tighten on the top, by a nut, or otherwise.

Where the situation of the mill admits of it, the boards are allowed to drop through, under the mill, as they are sawed off, a notch being cut into the stationary head block for that purpose; in this case a thin sliding bolt may pass through the block to support the board whilst being cut. When the board is not to fall through, the hinged braces, which have the cheeks on, are thrown back, the board then falls, and is removed.

What I claim as my invention in the before described machinery, is the manner in which the log is held in its place by means of the levers which press upon its upper side, acting upon the principle herein described; the manner in which the boards are gauged by forcing the log against the vertical cheeks before described; the construction of the progressive, or travelling, lever, which forces the log up without the aid of a crow bar, or other usual means; and the plan for allowing the boards to fall through the head block.

ENGLISH PATENTS.

To J. De Burgh, *Marquis of Clanricarde, a patent for improvements in Fire Arms, and in the projectiles to be used therewith, was granted on the* 15*th of July*, 1831, *and the specification was enrolled on the* 14*th of January*, 1832.

The improvements above mentioned consist in a moveable receptacle termed a sliding breech, into which the charge or projectile is immediately put, instead of loading in the usual way at the muzzle of the fire arm; and in the employment of a solid cylinder of lead divided into several pieces instead of spherical bullets.

In the specification is given an example of the application of these improvements to a large kind of pistol. The handle, cock, and other mechanical movements employed to ignite the charge, are much the same as in other fire arms; the barrel is provided at its breech end with trunnions, which enter apertures made into two strong iron plates fixed on the sides of the stock of the pistol; and a cavity is left between the two plates next to the end of the barrel for the reception of the sliding breech, which is internally made cylindrical for receiving the charge, and externally adapted to fit into its recess; it has a touch hole and tube for the application of a percussion cap, and turns upon an axis at one end into an inclined position, and by a motion of the hand, similar to that of half cocking a common gun; the charge being now inserted, and the breech shut down, its orifice is brought to bear in an exact line with the interior end of the barrel. In order that these parts may be accurately and firmly connected, the exterior edge of the orifice of the breech, and the interior edge of the orifice of the barrel, are turned to cones of similar inclinations so as to fit concentrically; and they are brought into close contact by a transverse wedge situated at the back of the breech, which by the action of a simple lever of great mechanical energy, moved by the thumb and fore finger of the right hand, (somewhat similar to that used in shutting down the pan of a common fire-lock,) forces the breech into the end of the barrel, and thus prepares the arm for being discharged. The sliding motion of the breech is only through the space of from a quarter to three-eighths of an inch, and it is guided laterally by the side plates—above, by an overlapping plate—and below it is confined by a fixed screw which works through an aperture adapted to it. The wedge, therefore, causes the breech to slide and lock all fast; and to reload, the lever of the wedge is thrown back by the right hand, and the fore finger of the left hand then laying hold of a kind of trigger, draws the breech out of the barrel, when the former is again turned up, and recharged with the projectile; which projectile is of the following description.

A solid cylinder of lead, about two and a half times the length of its diameter, is divided longitudinally by two cuts at right angles to each other, through its axis; and again by two other cuts transversely at equal distances from each other and from the extremities of the cylinder; thus producing twelve equal and similarly formed pieces, except that at one end of the cylinder a hole is made in the centre to receive some percussion powder. As the cutting of these pieces out of a solid cylinder of lead is attended with some difficulty, the patentee has constructed a mould for casting them of these forms. This mould is a tool consisting of three limbs or bars sliding over each other by being connected at one end to a common joint or centre. The cavities or moulds in each of these bars are short cylinders divided longitudinally as before mentioned by thin metallic partitions; so that by a tool of this kind the twelve separate pieces of the projectile are easily cast and cut off. This combination of pieces is then wrapped in paper with the requisite quantity of powder at one end to form the cartridge, which is made of suitable dimensions to fit the chamber of the sliding breech described. We should now state that the barrel of the pistol (or other arm) is made gradually to widen, laterally from the breech to the muzzle, where it assumes the form of an extremely long ellipsis, (its transverse axis being about three times that of the conjugate,) which will cause the pieces of lead to separate and spread laterally, so as to wound or destroy a great number of persons.

[*Reg. of Arts.*

To JEAN JACQUES JAQUIER *a patent for improvements in machinery for making paper, communicated to him by a foreigner, which he denominates Xeranothlipte, was granted on the* 31*st of August,* 1831, *and the specification was deposited on the* 29*th of February,* 1832.

M. JAQUIER prefaces the description of his machinery by stating, that in all the apparatus previously constructed for making machine, or endless paper, with the great wire lines, similar to those in laid paper (or that made in hand moulds,) the pressure given to the pulp to consolidate it, had the effect of cutting the paper through, or into ribands of the width of the spaces between the lines. With the view of obviating such a serious defect in this imitation of laid paper, M. Jaquier conducts the sheet of fresh pulp on the endless wire web over an extended series of horizontal rollers, whence it passes round the main cylinder without receiving any pressure; but during its extended journey to the main cylinder, it has acquired sufficient consolidation by constant drainage and the shaking of the machine, to be capable of bearing afterwards a slight degree of elastic pressure, which is produced by a small roller under the main cylinder; this roller is covered with several folds of "nappy cloth," partly to prevent its taking the paper off the mould, and partly to confer elasticity and a greater uniformity of pressure against the wires and the intervening paper. The operation of this roller so situated, gives the continuous sheet of paper sufficient strength and tenacity to allow it to be taken off the wire web, which is immediately done by the paper on the wire web being brought into contact with a roller carrying an endless felt of open cloth, to which the paper adheres in preference to the wire work mould. It is then carried forward by the endless felt, when the paper is made to bear against another series of rollers carrying another endless felt: the paper is thus pressed and drained between two cloths, before it is carried between the ordinary pressing rollers, whence it is delivered sufficiently manufactured to pass between the drying cylinders.

This invention appears to be of some practical value, and we should have given a drawing of it, had it not been so negligently and incorrectly specified as to render some parts unintelligible.

The claim relates to the mode of giving pressure to the paper after it has passed under the main cylinder, and to the subsequent pressure between two endless felts. [*Ib.*

To W. MASON *a patent for improvements in the construction of wheel carriages, was granted on the* 10*th of August*, 1831, *and the specification was enrolled on the* 10*th of February*, 1832.

THE intention of this patent is to afford the means of turning four-wheeled carriages without diminishing the size of the fore wheels, or cutting recesses into the frame work or body of the carriage for the reception of the wheels in the act of turning. This important object is proposed to be obtained by means of joints in the fore axle-tree, between the carriage frame and the naves, to allow the ends of the axle-tree to move horizontally backwards and forwards without altering the position of the middle portion, which remains eminently right across the carriage. At each of the joints, and connected with the portions of the axletrees which fit into the naves, is fixed a bar which connects the wheels with the splinter bar, to which it is jointed, so that the middle portion of the axle, the splinter bar, and these two side bars, form a parallelogram, which remains rectangular only, while the carriage is proceeding straight forwards. The pole of the carriage is likewise jointed to the middle of the axle and to the middle of the splinter bar, by which means any change in the position of the pole to the right or left will cause a corresponding change in the position of the levers constituting the before mentioned parallelogram, and consequently prepare the wheels for turning.

We have not deemed it necessary to enter upon the minute details by which the patentee shows in his specification, the proportions of the various parts of his arrangement, so as to afford the requisite strength to an axle with vertical joints, as what we have stated will be quite sufficient to give the reader a general idea of the principle and application of the invention. [*Ib.*

To Henry Hope Werninck *a patent for improvements in apparatus or methods of preserving lives of persons and property when in danger by shipwreck, by speedily converting boats or small vessels of ordinary description into life boats, and other apparatus or means applicable to the same objects, was granted on the* 24*th of September,* 1831, *and the specification was lodged on the* 24*th of March,* 1832.

This invention, which is said to be the communication of a foreigner residing abroad, consists in various methods of making and applying buoyant apparatus. The patentee first describes the method of manufacturing a buoyant balloon, made of a series of fifty or a hundred bullocks' bladders, which are to be cleaned and prepared by removing carefully the necks, and portions of fat which may be left adhering to them, turning them, and oiling well with linseed oil on both sides, then filling them with air, and securing well the aperture through which they have been filled by the introduction of a short wooden pipe, and a well fitted plug. The bladders are then to be attached to a hoop of an appropriate size, according to the weight which they are intended to carry ashore. Over this hoop and these bladders is placed an egg-shaped canvas bag, preserved in its distended form by means of a light cane basket. A bladder is also used, after having been prepared as above, for conveying a letter from a ship in distress to the shore. In this case the wooden pipe which is inserted into the neck of the bladder, is made sufficiently large to admit a letter rolled up. The aperture is then securely plugged up, and the apparatus committed to the water, on which it will float with a velocity nearly equal to that of the wind. This, it is contended, may be frequently the means of conveying to the persons on a lee shore, or to those on board other vessels to the leeward of the one in distress, intelligence in time for relief to be afforded.

Another method of making buoyant apparatus is described in this specification to consist of Dutch or other light rushes, or similar substances cut into appropriate lengths, according to the size and form of the intended apparatus. They are then to be tied securely together, covered with strong brown paper or pasteboard, or both, moistened and pasted so as to prevent the passage of air: after this a covering of bladder is applied, and the parts of which it is composed are securely cemented together; and, lastly, a canvas covering is to be applied, and the whole secured by resinous varnish and coal tar, so as to render the apparatus impervious to water.

Amongst the numerous instances which the patentee furnishes of the application of the buoyant bunches of rushes, are their introduction round the edge, over and under the seats of a common boat, to convert it into a life-boat, to a man's person in the form of a floating jacket or dress, to render him buoyant in the water, or round his waist, in the form of a large annulus or collar; and lastly, it is proposed that a horse shall be surrounded with a buoyant dress reaching nearly as low as the feet of the rider, so that the animal may be enabled to float on the water, without being at all sensible of either his own weight or that of the rider. [*Ib.*

To WILLIAM BINGHAM, *Esq. and* WILLIAM DUPE, *Gunmaker, a patent for certain improvements on fire arms of different descriptions, was granted on the* 24*th of September*, 1831, *and the specification was deposited on the* 24*th of March*, 1832.

THE introduction of percussion powder instead of flint and steel for igniting gunpowder in fire arms, has given rise to a very great variety of modifications in the construction of gun locks, and amongst others to the one before us, in which it is proposed to make the barrel terminate in an acute conical cavity within the breech, and from the apex of this hollow cone proceeds the touch hole to the priming nipple. The hammer, which is operated upon at once by a straight main spring, strikes the nipple within the stock, so that there appears nothing on the exterior but the handle by which the cocking is effected. The seear and the trigger are likewise much simplified, being but one piece. The whole arrangement is simple and ingenious, and appears well suited to the purpose for which it is designed, though there are many parts of the lock which approach very closely to other patent contrivances having the same object in view.

These patentees propose in addition to the foregoing, a very material alteration, and, we are inclined to think, considerable improvement in the manufacture of the stocks of muskets and other fire arms. They propose to make the whole, or at all events the principal parts of the stock of sheet iron, by which they contend that the cost of manufacture will be diminished, while the stocks will be rendered more useful, particularly when applied to military purposes; and much more durable, as they will, according to the specification, last almost forever. A piece of sheet iron is first cut out of the form of an isosceles triangle, whose central length is about twice its breadth at the base; this then is bent into the required form by means of a saddle backed anvil, or block, and suitable tools. It is then to be cleaned and painted, or japanned inside, to prevent it from rusting; then to be securely fixed to the fore part of the stock, which may be either made of iron or of wood, in the usual manner, according to the purposes for which it is intended; the preference is, however, given to iron. The butt end and the top are to be inclosed by soldering in plates made to fit the opening, but if the stock be intended for a soldier's musket, the end plate is made to open to admit a soldier's provisions, or ammunition, and thus the utility of the musket will be augmented. The exterior of these iron stocks is to be bronzed of the usual colour of gun stocks, or of any other, to suit the taste of the manufacturer or his customers. [*Ib.*

To WILLIAM DRAKE, *Tanner, a patent for improvements in tanning hides and skins, was granted on the 7th of October,* 1831, *and the specification was enrolled on the 7th of April,* 1832.

THE principal novelty in this patent consists in applying the tanning liquor on one side only of the skin, and causing it to ooze through the skin to the other side; from whence the aqueous portion of the liquor is chiefly abstracted by evaporation. The result of this process is said to be, that the skins are more thoroughly and uniformly tanned, and the operation is completed with *cold* liquor in ten *days* instead of ten *months.* If this statement should prove to be true, and we see no good reason to doubt it, the patent is one of great value and importance.

The specification informs us that the skins or hides to be tanned are to undergo the usual primary process of *liming;* they are then to be immersed and well *handled* in a vessel containing *backward,* (which is a weak solution of tan,) until thoroughly saturated, which removes the lime and prepares them for a stronger impregnation. Thus prepared, the skins, excepting such as are intended for *butts* and *middlings,* which are shaped accordingly, are to be rounded (i.e. their irregular edges taken off,) then two of them are to be laid together face to face, and be carefully sown together with waxed thread at their edges, so as to form a kind of bag impervious at the junction, leaving a small opening at the shoulder for the insertion of the neck or spout of a funnel shaped vessel; but, it is to be observed, it would be preferable to sew between the skins a collar adapted to receive the end of the funnel. As bags so formed would bulge out when filled, they are to be confined between two-gridiron-like frames of parallel bars adapted to compress the bag in such a manner as to produce internally a vertical stratum of liquid of about an inch between the two skins; and as the skins are thickest towards their middles this variation is compensated for, by cutting away a portion of the vertical wooden bars from a straight into a hollow curved line. The skins are suspended by loops to the bags, which traverse the upper horizontal bars of the frames, and the two frames are duly drawn together by four screw bolts passing through the extremities of the top and bottom bars. The funnel being inserted into the aperture between the skins, it is charged with strong tan liquor sufficient to distend the bag and leave a surplus quantity to supply the loss by evaporation after the moisture has penetrated to the outside of the bags; a small gutter at the bottom of, and between the frames, receive whatever liquid may drop from the skins, and conduct it into a vessel, by which it is returned whenever necessary into the funnel reservoir above. To prevent the compression of the vertical bars from forming permanent indentations and ridges in the skins, the patentee directs that the bags be occasionally shifted a little laterally.

To facilitate the evaporation, and consequently the absorption of fresh solutions of tan, the operations are recommended to be conducted in chambers artificially warmed, and the liquor which oozes through the skins, and is received into the gutters, is directed to be conducted into vessels acting the part of refrigeratories, in order that *cold* liquor may always be supplied to the skins; but how this liquor is to be preserved cold in a warm chamber, the specification omits to inform us.

When the skins are sufficiently tanned, which is well known by various indications to practitioners in the line, (chiefly, by their increased thickness, hardness, and russet colour,) a stitch or two of the sewing at the bottom of the bag is opened, and the liquor is received and carried off by the gutter underneath.

The claim to invention does not consist in the mere application of liquor inside of a bag formed of skins, but to the general combinations, and especially to the mode of accelerating the penetration of the tanning liquor by exposing the outer sides of the skins to evaporation.

Although we have a very favourable opinion of this process, and that great economy will result from its adoption, there appears to be one defect in it. The skins being laid vertically, the pressure of the column of liquid will cause a much more rapid absorption of the tan in the lower than in the upper part of the skins; and if no injury is produced to the lower by continuing the process until the upper is fully saturated with tan, there is at least a loss of time. It is also probable that the liquor is stronger at bottom than at top of the bag. From both these causes, therefore, we should not expect that the leather produced would be very uniform in its quality. To obviate these defects, we would submit to the patentee, as a preferable arrangement, (and one which will not affect his patent right,) to suspend his frames midway upon axes of rotation, and to fix at each end of his bag a charging vessel with a stop cock, or some other simple contrivance to answer the same object. The bags may then be reversed at pleasure, or placed in any desired position, and the lateral shifting required between the bars will take place of itself. If there were only one charging vessel with a stop to it, it would suffice, as by turning the frame round half way, it may become the discharging aperture. [*Ib.*

To WILLIAM LLOYD WHARTON, *Esq. a patent for certain improvements in engines for raising or forcing water by the pressure and condensation of steam, was granted on the 30th of January, and the specification was enrolled on the 30th of March,* 1832.

STEAM engines, on the principle introduced by Mr. Savary, are those intended to be improved by Mr. Wharton's invention; but instead of allowing the steam to come into contact with the surface of the water in the cylinder, he interposes between the two a large hollow float, of an exterior diameter very nearly equal to that of the interior of the water and steam cylinder. Over the water in the cylinder is introduced a quantity of oil, which passes up the sides of the float, and prevents the steam from ever coming into contact with the water to be acted upon. After the steam has been admitted from the boiler into the cylinder, and forced down the float, and consequently the water underneath, it is conveyed to a conical condensing vessel considerably elevated above the cylinder, where it is condensed by means of a jet of water admitted from another vessel situated immediately above the condenser. And thus a vacuum is obtained in the upper part of the cylinder, which allows the atmospherical pressure on the surface of the water to send up a quantity sufficient to elevate the float to the top of the cylinder, when the steam is again admitted to force down the float, and through that medium to force the water, now occupying the cylinder, to ascend a delivery pipe to the required elevation. The supply pipe is provided with a valve, opening upwards, to prevent the return of the water into the well, or reservoir, from which it has been raised; and the delivery pipe is also provided with a valve opening upwards, to prevent the return of the water into the cylinder when the vacuum is created.

A tumbler hammer is introduced for the purpose of opening the communication between the steam boiler and the cylinder, and closing the communication between the cylinder and condenser when the float reaches the top of the cylinder, and of reversing the stop cocks, or valves of these communications when the float reaches the bottom of the cylinder, thus rendering the engine self-acting as far as regards the opening and closing of the steam communications.

[*Ib.*

Patent granted to Benjamin Aingworth, *Button Maker, for an improvement in the making and constructing of Buttons. Dated August* 30, 1831.

This patent is for a minute improvement on that of Mr. Aston, of Bromsgrove. It is not that we, with Sylvester Daggerwood, have "a soul above buttons," but we find it extremely difficult to understand the exact degree of improvement to which the patentee lays claim. We had no idea that the mystery of button making was so abstruse. It appears from the evidence of Mr. Aingworth that a button could never be made at all, if it had its own way, and was not absolutely compelled to be a button. Animals are tenacious of life, but buttons show a yet more remarkable tenacity of nonentity. Would the reader believe it? Three plans are appended to this most voluminous patent, which occupies as much parchment as would make a million of buttons, and that these three plans represent an army of figures and a myriad of means to compel the reluctant elements of a button to cohere and become a button! First, a piece of cloth of a peculiar texture, is cut out larger than the size of the intended button; then two or three, or more pieces of thick paper; then a metal plate; then a bevilled steel ring; then *encore du papier;* and, "conclude with the cloth," as they say in quadrille dancing. So much for the materials, in which there is little new but the paper. These are divided into two portions; the former cloth, paper and steel, are put into a barrel, or rammer, or tube fitted into a bench, or frame, or,—may we name it?—a shop-board. In this tube, by means of a plug, the materials are pressed together. A similar barrel receives the other portions of cloth, steel, and paper, which are in like manner compressed. The two tubes are then united, and the whole of the component parts of the buttons are pressed together so as to form *one.* The edges of the cloth and paper are turned round the bevilled ring, and being then removed to a very pretty instrument of the press kind, the button receives its last squeeze, and comes out completed.

After all these perils, the button is supposed to be superior to any button that has suffered less. It can be stitched to the coat without an elastic neck; it sits more closely, and its soft edge does not wear the cloth as a metal one would do, (the ring, or plate, being wholly covered by the edges of the softer materials,) and Mr. Aingworth thinks that he has achieved much in making a button without a neck. We have no doubt that the improvement is great, but we cannot understand it. The more kinds of buttons the better; the more machines, the better; the more hands employed, the better; and the more patents the better, say we. We heartily wish that better times may come soon, that men may wear more buttons to their coats, and more coats to their buttons than the present times will afford.

[*Rep. Pat. Inv.*

¶ ROYAL ORDINANCES OF FRANCE RELATING TO STEAM-BOATS.

(Translated for this Journal.*)

Circular of 1*st June,* 1830, *to the Prefects of Departments in relation to the instructions appended to the Ordinances of* 2*nd April,* 1823, *and* 15*th May,* 1828.

SIR,—You have received the circular of the 1st of August, 1828, relating to steam-boats and to the boilers of the steam engines used in those boats.†

At the end of this circular will be found the two ordinances of 2nd April, 1823, (Bulletin of Laws, No. 601, p. 306,) and 15th of May, 1828, (Bulletin of Laws, No. 233, p. 497.)

You have doubtless attended to the formation of the committees of superintendence, to be appointed by the Prefects, (according to article 1st of the ordinance of 2nd April, 1823,) of the Departments in which there are rivers, or which are upon the sea-board, and where steam-boats are or may be established. These committees have very important duties to fulfil, in which the prosperity of commerce, as well as human life, is interested.

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* We observe that the translations of former ordinances made for this Journal have been transferred, *without acknowledgment,* to the pages of the Register of Arts, and Journal of Patent Inventions, (London.)—TRANS.

† See the translation in this Journal vol. vii. p. 272, 323, 399, and vol. viii. p. 32.

The ordinance of 2nd April, 1823, has left to the authorities the task of completing the details of the system.

I have published a special instruction, in order to facilitate the execution of the ordinances concerning steam navigation; and to establish, as far as is possible, uniformity in the local regulations which it is the duty of the prefects to draw up. It has been prepared after mature consideration by the committee of engineers of mines, and of civil engineers, (organized in 1823,) which have charge of all questions relating to the steam engine.

This instruction contains, in addition, explanations respecting the internal police of steam-boats.

You will find copies of it enclosed.

The instruction contains the provisions of the ordinances and directs the mode of executing them. There is an express prohibition against proving by the hydraulic press, (and consequently against stamping,) any boiler terminated by plane ends, which thus differs in form from the proper high pressure boiler.* These boilers, with plane ends, could not be proved without being put out of shape; they are only worked at very low pressures, and are not dangerous when provided with safety valves loaded directly, with fusible plates, and with an open steam gauge.

The instruction is divided into seven paragraphs, relating,

1st. To the superintendence and management of the engine.
2nd. To the feeding of the boiler.
3d. To the safety valves.
4th. To the fusible metallic plates.
5th. To the gauge.
6th. To the management of the fire.
7th. To the internal police of steam boats.

By the first of these paragraphs, it is made essential to the permit of navigation that there be placed on board of every boat intended for the convenience of passengers, an engineer whose *sole* business it shall be to superintend the engine. Great good is expected to result from this measure.

At the end of this instruction is placed a new table of the elastic force of steam corresponding to different temperatures. This table is the result of the labours of a committee of the Royal Academy of Sciences; their perseverance, courage, and ability, merits the highest eulogies. This table, (referred to in the circular of the 19th of May, 1825,) is to take the place of the table contained in the instruction of the 7th of the same month, provisionally reported by the academy.

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* This is a most singular prejudice, since the ends can be indefinitely strengthened to meet the strain upon them. It would entirely exclude from use the American high pressure boiler.—Trans.

I beg you, sir, to pay the strictest attention to the contents of the present instruction, and to enjoin the most attentive observance of its provisions on the various local authorities charged with assisting you, and particularly on the committees of superintendence in your department.

I request that you will send copies of it to each member of the committee, to the engineers of mines, to the government civil engineers, to the custom house officers, mayors and adjuncts, to the commissaries of police, to the commissioned and non-commissioned officers of gendarmerie of the cities and communes situated on the lines of navigation, as well as to the proprietors of steam-boats.

In acknowledging the receipt of the present, you will oblige me by sending the names of the members of the committees of superintendence in your departments. I desire further that you will report any changes which may take place in them.

I have the honour to be, &c.
(Signed,) Capelle,
Minister of Public Works.

Instructions relating to the execution of the Royal Ordinances concerning Steam-boats. To govern in preparing Regulations for the Departments.

Steam-boat navigation is regulated by the royal ordinances of the 2nd of April and 29th of October, 1823, 25th of May, 1828, and 25th of March, 1830.

By the first of these it is ordered that in the departments where there are rivers or coasts upon which steam-boats are, or may be established, committees of superintendence appointed by the Prefect must satisfy themselves that the engines and boats have due strength.

No steam-boat can have a permit of navigation, until the committee charged with its examination has proved its strength, and the good condition of its engine, and until the Prefect has notified the proprietor that he has received and approves the report of the committee. This notification should always be accompanied by a statement of the regulations which the Prefect may see fit to prescribe to the proprietor of the boat in relation to the general concerns of navigation. Lastly, formal visits of inspection, (and others,) must be made as often as is necessary by the committees, who must give, in their report addressed to the Prefect, their suggestions as to the measures to be taken in case the condition of the engine should require attention.

The regulations of the second ordinance, that of the 29th October, 1823, chiefly concern high pressure engines. A system of precautions is established, which, however, is well known, and has been applied for a long time to high pressure engines used in navigation; excepting, however, so much of the regulations as relates to the guard walls and to the space around the boiler, it being impossible that such arrangements should be made on board of boats.

The third ordinance, that of the 25th of May, 1828, contains among other provisions one by which the measures of safety prescribed by articles 2, 3, 4, 5, and the first paragraph of article 7th of the ordinance of 29th October, 1823, and also by the ordinance of 7th of May, 1828, are extended to the boilers, boiler tubes, cylinders, and jackets of cylinders of low pressure steam engines used in boats.

The fourth ordinance, that of 25th of March, 1830, concerns steam-boats in part, since it relates to low pressure engines in general. By this it is ordained that the safety valves of low pressure engines used in navigation, shall be loaded directly, and that every engine shall be provided with an open gauge, the length of which is to be determined according to the working pressure of the steam in the boiler.

It will not be difficult to regulate both low and high pressure engines of steam-boats in conformity to the different measures of safety prescribed by the ordinance just stated, if attention be paid to the instructions of 19th of May, 1824, 7th May, 1825, and 12th July, 1828, (which relate to high pressure engines in general,) and to the provisions now to be explained.

The stamps, formerly described, to be used for marking the results of the proof of a boiler, will be struck off at the mint at Paris, and inscribed with the words, *Ordinance of 29th of October*, 1823. It has not been considered worth while to sink new dies for the ordinances of the 7th and 25th of May, 1828, as these are only a continuation of those of 29th of October, 1823.

The degree of fusibility necessary to be given in each particular case to the metallic plates, has been heretofore calculated by means of a table constructed provisionally and published by the government at the end of the instruction of the 7th May, 1825. Since then a set of experiments has been made by the Royal Academy of Sciences to determine, with precision, the elastic force of steam at different temperatures. The result of these labours will be found in the exact and extensive table inserted at the end of this instruction, and hereafter to be used instead of the provisional table.

The makers and proprietors of steam-boat boilers are informed that they can always procure, as heretofore, at the manufactory of M. Collardeau, not only fusible metallic plates, for all required temperatures, but also fusible metal in bars. But it is necessary at the same time to state to them that it is difficult, without practice, to obtain, from the metal in bars, plates which shall fuse at the same degree precisely as the bar itself; it will be much safer for them to make use of plates which have been cast at the manufactory, as these are carefully tested after being made.

The fusible plates should be at least five-eighths of an inch thick, and should be covered on the outside with a cast iron grating to prevent them from swelling out when they are heated near to their fusing point. But in using these gratings it is necessary to increase the diameters fixed by article 5th of the royal ordinance of 29th October, 1823. This increase of size should be such as to make the free surface of the more fusible plate equal to the surface of one of the safety valves, and the free surface of the less fusible plate quadruple that of the surface of the same safety valve. Manufacturers and owners of boilers can obtain at the above mentioned manufactory gratings prepared for plates of all sizes, and so arranged that they can easily be fixed to the boiler and removed from it.

The use, on board of steam-boats, of boilers, and boiler tubes, of cast iron, having been prohibited by the ordinance of 25th of May, 1828, the boilers and boiler tubes of wrought iron, or sheet copper, used on such boats must be proved, (according to the terms of that ordinance and the one of 7th of May, 1828,) under a pressure triple of their ordinary working pressure.

No boiler which is terminated by plane ends, and therefore differs entirely in its form and arrangement from the proper high pressure boiler, shall be subjected to this proof, consequently none such shall be stamped.

Boilers with plane ends could not be subjected to the prescribed proofs, without being put out of shape by them; the proof by the hydraulic press is in this case so much the less necessary, as such boilers are seldom used under high pressures. These boilers work at very low pressures, rising at the highest to an atmosphere and a half.

While such boilers are exempted from the proof by the hydraulic press, their use is absolutely prohibited for pressures exceeding an atmosphere and a half. When used their safety valves must be loaded directly with a weight equivalent at most to half an atmosphere, that is to say, with a weight of seven and a half pounds for every square inch. Further, fusible plates corresponding to the temperature of steam of the pressure of an atmosphere and a half must be adapted to the upper part of the boiler; the first of these plates, i. e. the smaller, should fuse at 251½° Fah.,* and the second, the larger, at 269½° Fah.†

The cylinders, and jackets, of engines having boilers with plane ends are by no means exempted from the proofs, which, in this case, must be applied as usual, and the cylinders and jackets shall then be stamped an atmosphere and a half.

If it be necessary to adhere strictly to all the prescribed precautions in the management of stationary engines, even more attention should be given to those of steam-boats. In such cases recourse cannot be had to walls, &c. to ward off the effects of explosion, and when accident occurs the lives of a great number of persons are necessarily jeoparded. The local authorities cannot, therefore, exercise too much activity and foresight in the use of the powers which have been confided to them in respect to steam navigation.

Too much care cannot be taken, particularly by the committee of superintendence, in conducting the examination which must precede every permit of navigation. In their report they must give an exact account of the state in which they have found the principal parts of the engine of every boat. They ought especially to satisfy themselves that the arrangement of the fire cannot give rise to any accidents, that the play of the pump for supplying the boiler is sufficiently great, and that the working power of the engine is sufficient to overcome all the obstacles of the projected navigation.

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* 122° Centigrade.

† 132° Centigrade.

The royal ordinance of 2nd of April, 1823, has given to the local authorities of each department, the power of filling up the details of the general system of precaution. The authorities should hasten to use the power entrusted to them; many prefects have already done so with success. As it is material, however, that there should be as much uniformity as possible in all provisions of this nature, we now bring into view the principal points to which attention should be paid in drawing up such regulations.

[TO BE CONTINUED.]

¶ ON WORKING IRON AND STEEL.

The thanks of the Society were presented to C. VARLEY, Esq. for the following paper.

THE society having favourably received the description of my late uncle's method of condensing brass, in which I endeavoured to show the conditions which are requisite for the *extreme* and *uniform condensation* of metal previously sound; and knowing of how much consequence it would be to secure the soundness of anchors, iron tires, girders, and other implements, to which the safety of human life and property are so often trusted, I am encouraged to pursue the subject, and to endeavour to show the means by which iron or steel may be rendered sound, and preserved so while working, and even during welding. But on a subject supposed to be so well known, and in which I must repeat much that is known, for the sake of connexion, it may be well to justify myself by showing, in the first place, how inadequate the ordinary practice is to prevent unsoundness.

Iron.

The welding of numerous layers of good iron together, so as to form one bar, is considered to render it much tougher and more trustworthy than if it had been wrought out of one piece; for it breaks joint with, and equally mixes the strong and weak parts. But many stop here, believing they have done all they can; yet every welding may be discovered which proves that a considerable degree of unsoundness accompanies this process.

If we notice the pump handles about town which are constantly exposed to the weather, some are found where the continual wear from handling exceeds that of the weather: these acquire nearly the best polish that soft iron is capable of. But there are many in which the wear from handling barely keeps pace with the decomposition by weather; in these, the last weldings which united the different parts together to form the handle are most distinctly marked, and the various layers of which the mass has probably at different times been formed may be seen, very much resembling the longitudinal grain of wood. Here is sufficient proof of the want of homogeneity; and, seeing it is a constant attendant on welded iron, we are led to inquire what causes the necessity for welding. The answer is, first, the acknowledgment that iron is liable to invisible unsoundnesses, and that by welding they are likely to be distributed among sound parts and thereby equalize the strength of the mass; secondly, that there is a certain thickness beyond which the most governable hammers fail to produce the full effect of condensing the iron all through; and this thickness being far short of that required for anchors and other implements in which the utmost soundness and strength are wanted, such can only be made up by welding. Within that thickness there is no direct necessity for welding; but beyond it we have no means of rendering the whole mass sound. This necessity of sometimes having recourse to welding renders it of consequence to know what there is in the process of welding that makes the laminæ visible.

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* From the Transactions of the Society for the encouragement of Arts, Manuactures and Commerce.

When newly reduced iron is hammered till it becomes quite malleable and well closed or united, it may be considered homogeneous and sound, from its having no weldings and no carbon, this latter being carried off by the oxygen of the bar, and the beating. Whatever oxygen the surface imbibes in after heatings is beaten off in scales while giving the required shape to the bar. It therefore remains as sound and free from oxygen as before; for oxide of iron is not only brittle, but incapable of uniting by welding with malleable iron.

But when two such masses or bars are heated for welding, they become again coated with oxide; and then, when laid one upon the other and submitted to the action of the hammer, the oxide is shut in, and union of the bars can only take place in proportion as the two plates of oxide are broken up and the subjacent malleable particles are brought into mutual contact.

From this intermixture of oxide and metal arises a spongy texture (more easily acted on by the air than the pure solid metal,) which distinguishes the welding from the rest of the mass. If, therefore, several layers of good iron were welded together and beaten very much out without hammering the edges, on filing these square and cleaning the four sides, a little weak acid would soon distinguish the edges of the layers from their flat sides, and they might probably be counted.

But in ordinary practice iron is never left so: it is beaten in all directions, to give or keep the required shape, which so bends and distorts the layers that they are liable to be found in all directions; yet the lamellar structure remains, however much broken, and when obtained in a suitable degree, contributes to give that ornamental surface called *damask;* and as all much elongated iron, such as nails, wire, &c. show a fibrous texture when acted on by weak acids, this intermixture of oxide may cause variation in that texture.

Now the evils which arise from oxidizing the surface increase with the size of the weldings; for the great length of time the surfaces of large masses must be exposed to an urgent fire to obtain the welding heat, will cause so deep an oxidation that the union will be so much the more difficult to effect; for there needs a proportionate increase of hammering to break through a thicker coat of oxide, while the difficulty is increased of transmitting the force of the hammer through larger masses to the welding surfaces; so that the union is liable to be as much less perfect as the mass is greater.

Accordingly, as it is very common to meet with anvils whose large beak, and sometimes other parts, are broken off at their weldings, showing how very imperfect the union was, and that only at the edges, and seldom any at the centre.

And as an acknowledgment, by a workman, of the general deficiency of weldings, the society, in 1820, rewarded Mr. R. King for his method of avoiding them, by forging the anvil top, its beak, and opposite overhanging, in one piece, the base in another, and then welding the one on the other; so that in use this welding is the least exposed to strain.

Again: We frequently meet with iron wire that will strip in two like splitting a twig, and sheet iron that will split or peel up in parts; all showing either the inability of producing complete union or of knowing when it is effected.

I have thus far traced the unsoundness which accompanies welding: next I shall show what takes place when the weldings are quite sound; and shall pursue it, if possible, to the obliteration of every sign of previous welding.

If we recur to the melted carburet of iron, which is puddled or brought to a pasty state, and then hammered at a great heat till it has lost all its carbon, and till every part of the metal has united in one mass and become malleable, and observe what takes place during the process, we shall obtain a tolerably good hint for welding. The iron is still considerably divided by an excess of carbon, and probably by other impurities not easy to be defined. These are fast oozing out, and the carbon is burning at the surface, while the hammer is continually bringing portions of the iron into closer contact, so that they unite; and the pure metal being much stronger and tougher than the crude, it will keep together and combine with every particle of sound metal with which it comes in contact while the crudities are exuding; and this goes on, to the improvement of the quality, so long as any carbon remains; for, during that time, perfect welding must go on, because the carbon takes the oxygen and leaves the surfaces pure or clean for union. Thus the iron becomes one solid mass free from oxygen; for oxygen and carbon mutually take each other away in the form of gas, and leave the iron pure. Now, if ever so much hammered after this, the iron may proceed to perfect soundness and homogeneity; but it will be at the expense of the surface, which is detached in scales as it passes to the state of oxide, in which state, as I have before observed, it is incapable of uniting with metallic iron.

The conversion, however, of crude into malleable iron is never perfect till the mass is so reduced in thickness that the welding force of the hammer is felt all through; and then if all the oxygen is removed from within, it may be obtained quite free from flaws (at least all but minute ones,) and is fit for use.

Having thus established some thickness up to which, with given tools, new iron may be obtained sound, we begin to increase that size by welding; and here begins a new and very different cause for unsoundness, which will require our farther notice.

Various means have been resorted to in order to protect the surfaces of iron from oxidation while in the fire, such as sand, glass, salt, or any thing that will bear the fire; but these require to be scraped off before the bars are put together for union. Now, any portion of such matter that is not removed is itself a cause of unsoundness, and when perfectly removed, a thin coat of oxide forms on the clean surfaces and is shut in.

In order to obviate this latter evil, the iron should be coated with carbon, as though it was to be case-hardened, by immersing or laying it on a bed of carbonaceous matter, kept very hot till it has imbibed enough to engage all the oxygen that would otherwise attack it during welding: moreover, this carbon blazing out at the surfaces, helps to keep up the heat till they completely meet together. The surfaces ought also to be slightly convex, that welding may begin at the middle (that part being liable to receive less impression from the hammer,) and proceed gradually to the edges: thus the blisters that are liable to be produced from the union of oxygen and carbon are more likely to be beaten out. And more particularly as the masses singly were as thick as the hammer can govern, and now being doubled, its effect is lessened at the welding surfaces, therefore more care is required in the mode of bringing them together; for unless each part is kneaded together enough to adhere before the heat lowers, some parts will only be beaten close without union; and all after heatings affect the outside more than the joint. Also, if any air is shut in, this likewise retards the union; but a convex surface gives the best opportunity for it to escape.

Next, supposing the iron protected as usual, if, at the moment the substance used for this purpose is well scraped off, the surface is sprinkled with good cast iron, or still better with cast steel filings, this addition will introduce carbon enough to engage the oxygen, and a sound welding may be expected. Here the operation is similar to the original reduction of the iron to the malleable state; for perfectly clean iron unites very readily if brought into close contact at a suitable heat.

This process for uniting iron which otherwise was too thin for welding has lately become public, and by some has been called soldering, under the notion that the cast iron melted between the surfaces.

Iron is too thin for welding if it cannot retain the heat long enough under the hammer (or when the remaining good metal is not enough to squeeze through, or mix up with the oxide) to unite, without being smashed to pieces by the hammer; or if so much flies off in scales that the remainder becomes useless. But by the introduction of highly carburetted iron, the oxygen is consumed and the heat thereby retained a little longer; and the metal becoming all good, or restored, there is rather an addition than a diminution of weldable substance; and a much less use of the hammer will bring the whole into union.

Now, seeing by this means much thinner iron is united than formerly, it is desirable to apply the same process as completely to large work. For though the mechanical obstacles appear so opposite, the opposing agent, (oxygen,) is the same, and is nearly in proportion to the masses.

Small work, being quickly brought to the heat, is less burnt than large masses; for these, requiring much time to arrive at the necessary heat, receive a deeper coat of oxide. Small work, however, is more disfigured in proportion, by the beating requisite to cause union; whilst in large work the quantity of metal between the hammer and joint resists the operation.

In one case the work is worth nothing unless the iron is preserved; in the other the joint is not sound unless oxygen is excluded, because it can never get so much brisk kneading together as to overrule the enclosed layer of oxide, and force union.

A third method I would propose for very large work, is to protect the surfaces in the most convenient manner while coming to the heat; then carefully cleaning them and laying a thin sheet of clean hot steel that has been highly carbonized between them: this would secure a very sound and equable layer of metal all through the joint, the carbon of which, if more than enough to reduce the oxide, would still not impair the soundness of the metal, and consequently do no harm to the joint.

If by some of these means, either of excluding oxygen or removing it in the process, we are enabled to effect a sound union, we may add layer upon layer of sound metal, till we have obtained the largest required mass. Yet this may, perhaps, be only apparently sound; for here another evil is liable to be introduced, which before was stated to need our attention; and if this is allowed to enter, it will increase with every additional layer.

In order to explain this, let the layers be supposed to be added in succession, all on one side of the first, bearing in mind that we are using the thickest layers which our hammer can govern.

When two are welded together, the upper one is stretched most by the hammer; it is therefore pulling the under one with it, which, if it cannot do, it will divide the exertion by curving a little to it. Now here at once the mass is in an unnatural state of tension, the under piece being stretched like a cord, while by its force it is striving to bend the upper one like a bow. Now, a third layer added on this, will, in like manner, be stretched more than the under ones; and while endeavouring to stretch the second one like a cord, it becomes the antagonist of the first, and would overcome its power to bend the second; but as its relation to the second is precisely what the second is to the first, a strong tendency to a curve is still the result. Now, on proceeding to add the fourth, fifth, sixth, &c. layers, we are continually increasing the stretching force on one side. Therefore these additional layers must either all bend, or the under one be so stretched as to break or become unsound; for the farther the bottom layers are removed from the hammer, the more do they act merely like an anvil, suffering less and less alteration from the hammer.

Now, if instead of adding only on one side, we added as many layers on the three other sides (leaving the first as a central nucleus) while hammering the outside layers, they would all be enlarged; the inner ones serving little more than the office of an anvil, are, therefore, stretched till they break.

This kind of mischief begins with the first welding, and increases with every layer, and is greatly increased by the quantity of hammering required completely to form and finish the work. For the more the outside is extended by the hammer, the more the inner part is stretched; and as this will bear but little of extension without parting, the mass must become unsound. Agreeably with this, it has long ago been observed, that large masses hammered beyond a certain degree lessen in specific gravity instead of increasing, and therefore it was supposed that a large ball might be hammered till it became hollow. Now, whether the layers be added in succession, or are all heated by welding together at once, the effect will scarcely be altered, for it will require as much hammering fully to effect all their unions, and there will be the same gradation of the hammer's effect; for the outside will be drawn out in length more than the inner. This is shown by trying to lengthen a cylinder by a hammer rather too small; for then the centre not lengthening equally with the part directly acted on by the hammer, the ends will become hollow, and the force of the extended outside will stretch the middle parts to unsoundness. The use of enormously large hammers will carry us farther in size before central unsoundness takes place, but then the surface is the more furiously smashed about.

It remains to offer means of preventing or diminishing this central unsoundness; for though in large work the tools would be expensive, yet where the repetitions are frequent, that is of less consequence; and if one ship was saved by the greater strength of its anchor, it would surely be an offset against the most expensive tools.

The bars, which are to be united into one great shaft or stem, should be all of one length and of the full width; then an anvil or bed of iron should be provided, so large as to contain a recess of the same dimensions as the intended shaft. Through the bottom at each end, and flush with it, iron posts might stand so that they could be raised by levers at their bottom when the work required to be lifted out. Now, prepare two of the layers for welding, and put them into the recess, and have a stamper or welding hammer square ended, as wide as the recess, and let it drop from a carriage travelling parallel with the recess; in this case there is no room for extension either in length or width, the metal can only close, and as there is no lateral spreading to make way for the hammer, its force will be directed more effectually downwards; but as its face would be too broad for its best effect, two men, with a frame like a hand barrow, might carry a short cylindrical hammer-like punch under the stamper, and distribute the blows equally all over. Where this cannot be done, placing the hammer over an anvil, with two heavy cheeks adjustable to the required width, would prevent lateral spreading and lessen the evil, though it could not prevent the longitudinal stretching. But by whatever means the workmen can prevent all extension under the hammer, soundness will be preserved. The above process being performed on two layers, then bring the mass thus produced to a welding heat, and add a third layer, and so on in succession.

If a ball of clay or putty is rolled into a cylinder, it will show hollow ends, proving the outside to have extended most; and the centre being cracked by the stretching, at last breaks the cylinder all through, and it falls to pieces with cracks sharper than the softness would lead us to expect. I have seen brass wire full of cracks at which it would break, occasioned either by very hard drawing or brittleness of the metal, and these breaks were convex, fitting into concaves, showing that the centre had travelled faster through the hole than the outside; for the convex was towards the hole before it had passed, and from it when passed, and the last end of wire is frequently hollow.

Now, seeing large masses are so liable to acquire internal unsoundness, and the weldings also difficult to obtain sound, I would, in constructing anchors, totally avoid all weldings across the pull to which they are subjected when in use.

I would therefore take new iron that has only been reduced to the malleable state, in pieces long enough to forge into the complete form of the intended anchor, without flukes, and thin enough to be quite manageable under the hammer. Having provided a quantity of these, I would weld together (as previously mentioned) by carburet of iron sprinkled between them, a sufficient number to give the required thickness, with some contrivance to prevent all extension, but should prefer a recess capable of receiving the whole anchor. This would produce square limbs, and I should prefer chiselling off the corners to hammering them in; for if they were hammered in, it would put some parts in a state of greater tension than others, and destroy that equal ease throughout, which is so very essential in an anchor, where every part should contribute equally to bear the strain; for those parts that are left in a state of tension chiefly bear the pull, and must give way before the others can come to their full tension; therefore the anchor breaks. Perfect soundness of the iron, an arrangement of the weldings so as to be in a line with the pull and ease of all the parts, or an equality of their state and freedom from tension, are the three most essential requisites in an anchor, after its form has been determined.

From these considerations, I think it will appear that many anchors are rendered unsound by the hammering, and that the metal is liable to be put into such an unequal state of tension, that one part at a time only bears the strain; so that with the weight of a large anchor we have only the strength of a small one; and when this is the case, can we wonder at their breaking?

There remains yet another view in which the use of large implements should be considered; namely, at what thickness can any given material be used with the best advantage. This leads to the inquiry, whether there are any limits in this respect as to thickness and length; and if so, what is their nature, and do any implements exceed those limits.

Now, an anchor is the largest hook in use, and is exposed to rougher, or more violent usage than any other, and that even in proportion to its greater size, on which account it ought to possess every good quality of metal. But I fear this inquiry will show that the largest anchors do exceed the limits of some of the most important qualities.

To seek for these limits, we must look at matter much reduced in size, and compare it with the largest masses, and we shall find a greater contrast than in size.

Small pieces fall from any height without breaking, the blow they give or receive not being equal to the force of cohesion between their particles. Now, on increasing their size, the sectional surface to be broken increases as the square, while the weight increases as the cube, therefore large bodies break from falling.

If we sufficiently reduce the thickness of very brittle materials, such as glass, they are found to be flexible: glass may be drawn out so thin or fine as to bear twisting together and forming thread, and it bears throwing about; while the same substance in rods two or three inches thick, will break rather than bear bending enough to be discovered by the nicest measurement.

If we could have wire so small as to consist of one line of particles, it would lose all character of stiffness, and bear unlimited bending (such an imaginary wire may be imitated by a line of small magnets between two large ones;) and if it consisted of three or four lines of particles, no bending could remove them out of the sphere of their mutual attraction; such a wire, therefore, would never break. Now, the smallest soft iron wire bears so much bending about, that it appears, in this respect, more like lead than iron of large dimensions.

This flexibility continues so far, that soft iron wire, about one-eighth of an inch thick, may be bent double, while cold, without fracture. Here the outer portion *a b*, fig. 1, about two thicknesses long, is bent and stretched into the curve *a b*, fig. 2, about double the former length; the fulcrum round which it begins to bend is probably one-third within, but it must ultimately remove to the outside, as will be seen by the figure.

Fig. 1.

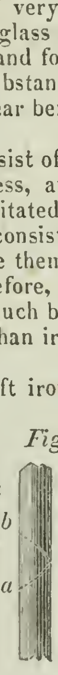
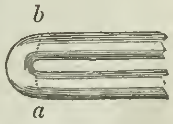


Fig. 2.



We may observe that a considerable angle is made before there is much stretching: this is of the greatest consequence, as it immediately engages a longer portion of the metal to stretch and contribute to the bending; for where there is any curvature the metal is stretched: this will be understood by bending wire into a spiral round a very small axis, when it will have a constant succession of bending parts, and the whole outside will be stretched. Now, after the angle is made, the outer side, while bending and stretching, is forcibly pulled closer towards the fulcrum, therefore, the change of place of the particles is not so great as it appears; and the reason the wire seems not to have lost any thickness at the bend, is owing to the bulging out of the inner side, nearly making up for what is lost on the other; the inner portion is so hardened by the pinch, that there is a little lateral sliding round it while making the bend.

Now, supposing we have begun with the thickest wire that will bend double, let us take some of twice that thickness, the sections of the bending portion will contain four times the surface, but the quantity of metal engaged in bending is eight times as much; therefore the amount of its cohesion is now doubled; and in consequence this wire cannot be bent so much as the other without breaking.

Next take a rod of ten times the diameter of the wire; its sectional surface, the cohesion of which resists breaking, will have increased a hundred times, while the quantity of metal to be bent is increased a thousand times; this is ten times as much in proportion to the cohesion, and the lateral change of place among the particles requires also to be ten times as much: but we supposed the first wire to be the thickest that would bend double, consequently there was all the change of place among the particles that the metal could bear; but in this latter case, ten times the former amount of change of place being required, with ten times the proportional quantity of metal to the cohesion, the rod must rather break than bend.

Steel or iron wire one-twentieth of an inch thick and a foot long, will bear throwing about any how, and suffer little from bending; but if, with the same proportions, the thickness be one foot, the length will be 240 feet, and its weight somewhere about 80,000 lbs.: this, it is evident, could not bear falling from a height proportionally great, or even being lifted from one end like the smaller.

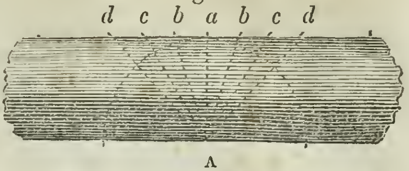
Thus the power of bending decreases as the thickness increases; therefore, in very large masses it is almost nothing; and this same reasoning applies equally to the springing power of large masses.

Now, seeing that brittle bodies become flexible by reducing their thickness extremely, so the most flexible bodies become, as it were, brittle by greatly increasing their thickness: therefore, I think we may come to this conclusion, that there is a given thickness at which metal loses all power of springing or bending, and therefore a blow powerful enough to require its yielding will be sure to break it, because it cannot yield in any other way.

We may notice that after a certain quantity of bending, the iron becomes so unequally stretched, that some parts are rendered weaker than the rest; these cannot bear the same exertion, and so must give way.

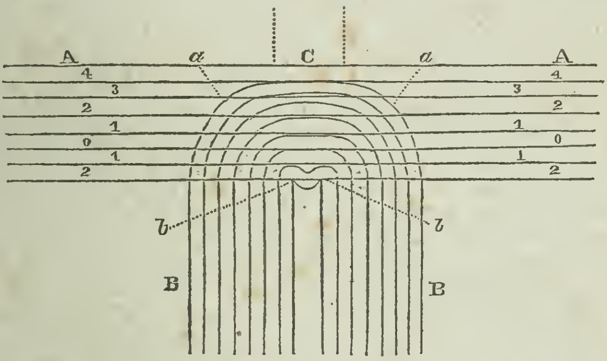
When a bar receives a blow, or takes one by falling from a great height, it must either spring, bend or break, at the part struck, because the section there is the shortest, as at *a*, fig. 3. Supposing A the fulcrum or blow, the sections *b c* and *d* rapidly increase in length, and therefore soon limit the portion whose strength has to resist or oppose the momentum or weight of the two ends, and when it bends, the section *a* is most stretched, *b c* and *d* successively less as they are longer; therefore *a* is the only part stretched to the utmost; but when a curve is made by a little bending, then there is just so much added that can stretch like *a*, or at least like *b*.

Fig. 3.



It may, perhaps, be allowed here to give another view of what takes place while bending. We will suppose a bundle of square rods A A, fig. 4, perfectly fixed together at their ends, so that they cannot slide, to be forcibly bent as to B B. In this case the rod marked *o*, or one near that place, would simply bend; No. 1 below it would thicken and shorten, while the bottom one 2 would bulge out, making three bends like the letter M; then Nos. 1, 2, 3, and 4, above, would all have to stretch as well as bend, and while their middle was stretching there would be a little sliding round the fulcrum or the two shoulders formed in the lower bars, the upper bar stretching most, and the middle part C in all four of them stretching more than the adjoining parts, as is shown by the sections in fig. 3. Now, if instead of the rods being so small as to bear bending, we suppose each rod to be the thickest that will bear to be bent so much, it is evident they will not bear the additional quantity of stretching and sliding requisite to allow of their taking the form B, B, for the parts *a a* would have to descend to *b b;* a portion *d d*, as wide as the fulcrum is thick, is pulled straight just before rending, and in all cases of bending that straightness is a signal to go no further, for the bar will break.

Fig. 4.

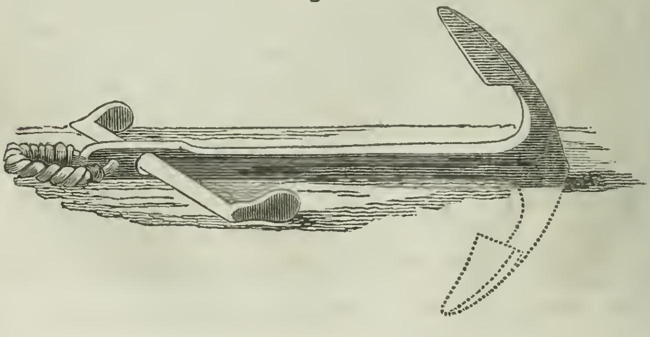


Now, seeing the power of bending or springing decreases as the thickness increases, and that the weight (the momentum of which endeavours to break any body which falls suddenly on a hard resistance,) increases as the cube while the strength increases only as the square, I think it will follow that anchors ought to increase more in thickness than in size, in order to make up for their loss of flexibility, and enable them to fall without breaking.

This leads us to inquire whether anchors are formed so as to answer equally well their three principal services: the first, to be sure of taking hold; the second, to bear the great strain and jerking to which they are subjected while in use; and the third, to bear falling; and sometimes a fourth, the capability of being withdrawn from a good hold.

With respect to the first, the flukes are probably as broad as the strength of the anchor will bear; for if they were broader, they sometimes would be liable to be twisted off when the ship swung round with the tide; and the form of the hook is evidently good for taking hold, and running that hold up to the shank; but as the fluke is the chief resistance, the arm should begin to curve from the fluke gradually into the shank: but the wooden stock which obliges the anchor to take hold, offers as much surface to the ground as the fluke does; this added to the rising angle of the pull, prevents the whole anchor from diving through soft ground to a harder bottom in which it can hold. The power of diving might be given by using iron stocks, made to turn in the anchor, with the arms, fig. 5, flattened, and round disks at their ends turned inwards enough to make the flattened arms present their edge to the sand or mud in such an angle as to be able to dive. Again, it is not well to drop an anchor with any additional weight, as that would tend greatly to break it; but if a stop were put on all cables three or four fathoms from the anchor, and a weight like a collar allowed to run down the cable to this stop whenever the anchor was found to drag, it would cause such an angle in the cable as to make the portion between it and the anchor lie on the ground and pull horizontally: this weight would also act like a spring, for when the ship tugged at the cable, endeavouring to straighten it, it would have to raise the weight before the anchor could feel the tug, and then it would never be so sudden or so much upwards as without a weight.

Fig. 5.



With respect to the second condition, the action of a hook is the severest strain that metal can be put to; therefore, nothing but the most careful gradation of form, regularly increasing the strength from the stock to the bow and from the fluke to the shank, and curving the shank better into the bow or arms with really sound metal, can distribute the strain equally.

Thirdly, the bearing a fall: an anchor is so formed that it cannot drop on a hard bottom without strain somewhere; and as we can only meet this by increasing the thickness more than the size, and as with this thickening it will be gradually losing the form of an anchor and approaching that of a block, it becomes a query whether, for the largest anchors, Parks' mooring block (which was rewarded by the society in 1818, vol. 36,) is not the best, weight for weight, because it will dive till it finds hold, and a stopper may be put on the cable to prevent it from diving too deep to be easily withdrawn.

There are two somewhat similar operations by which metal is fitted for our use, that deserve our consideration, because in one it evidently loses strength laterally, although it gains it longitudinally. These are wire drawing and rolling out into plates: in one case it is drawn through holes successively reduced in size; in the other it is drawn between hard rollers successively placed nearer to each other.

This produces a character rather extraordinary for metal, for it becomes fibrous; and this texture may be satisfactorily shown, by submitting a piece of it to the slow action of weak acid. Some have attributed it to crystals which kept their separate character while being elongated. But if we carefully trace the progress of the metal through the holes or between the rollers, we may probably find sufficient cause for an elongated or fibrous texture.

The metal is caused to pass through the holes by pulling and not pushing; therefore the quantity reduced each time must be small compared with the thickness of the wire, because it is the mere tension of the reduced part which causes a complete change of place among the particles, or the squeezing of larger rings or short cylindrical portions successively into a smaller size, and elongating them in proportion. This elongation takes place in the hole, where the metal is stretched nearly to the utmost, and it may be considered as analogous to drawing a cylinder or core out of a tube; and this core is so much stretched as to receive into itself the whole of the outer coat, which thus sinking in becomes part of it and follows by its cohesion. Now, as these successive rings are too large to go through the hole, they cannot contract and dive into that below but by a longitudinal sliding of the particles, some sliding aft to let the others close and proceed through the hole. Now, as the elongation is unlimited while there is room to reduce, the centre would be torn asunder, did not the outer metal dive and fill it up; then, as cohesion, or the power which resists parting, is the cause of this, the whole portion at the hole may be considered almost as in a liquid state while passing through it. During this motion and change of place among the particles, if there is any sort of polarity in them, this is the time they are called into action, and can arrange themselves, and that arrangement must be longitudinal; but the longitudinal sliding of the particles to allow some to proceed first through the hole, and the continual wedging of portions of the outside into the central parts to supply the current of particles through the hole, (for it is like a current,) the particles re-arranging themselves and following by mere cohesion, appears sufficient to produce a tendency to longitudinal fissures, by which the coherence is somewhat weakened, although no real division takes place.*

In the flatting mills the revolution of the cylinders helps to carry the metal through; in that it differs from wire drawing; but though there are no side stops, the metal scarcely spreads any thing in width, proving that there is no pressure of the particles together laterally, but that the mass is elongated just as the thickness reduces; here the rollers pinch tight the reduced part and forcibly carry it through; while the thicker part, like a wedge, refuses to follow, so it is stretched somewhat like wire drawing and the surface is driven back in waves. Here the whole action is lengthwise, and each line extends without regard to its neighbouring lines, so that its lateral adhesion is weakened; and as a thin plank will bend lengthwise, but will split rather than bend crosswise, so will hard rolled plate metal. Annealing and hammering once or twice till hard again, by distributing the extension in all directions, removes this parallel fibrous character. This change of character, according as the metal is worked, shows that none is so strong as that which is beat in a recess; and I think no fibres could be discovered in such metal; for, if I may use the expression, it would be one fibre spreading every way; in fact, it becomes quite dense and homogeneal.

I have now endeavoured to show that oxygen entering with each welded surface deteriorates the iron; and have proposed some and pointed to other means which have been found capable of avoiding it.

Also, that the difficulty of transmitting the force of the blows to the inner surfaces increases with the thickness, and therefore limits the thickness at which sound welding can be obtained.

And when the hammer is used for lengthening a mass, the outside is chiefly elongated, from the effect of the hammer regularly decreasing as the centre is farther from the surface; so that, at last, it receives no impression, but, with the mass below it, serves only the office of an anvil, merely helping the hammer to extend the outside, in which case the centre always becomes stretched, and thereby weakened, and sometimes torn asunder; and as each side while lengthening under the hammer endeavours to bend the mass, it causes an alternation of the stretching, or springing, so as to facilitate the cracking of the centre.

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* When reducing some thick wire in the lathe, to make a small screw with a large head, it proved so unsound at the centre as not to bear reducing to the required size; it did not break off, but tore aside; and on twisting it about with the pliers, the whole of the reduced portion appeared fibrous, so that the wire seemed to have a pith within it. In this instance the centre must have stretched more than the outside could supply while drawing. It would be desirable to try which would give the soundest centre,—the reducing wire through the fewest possible number of holes, or greatly increasing their number and bringing the wire down very gradually; then drawing some very slowly, and some as quickly as possible.

Thus, while small masses are rendered dense and stronger by the hammer, large ones suffer loss of strength if very much hammered.

[TO BE CONTINUED.]

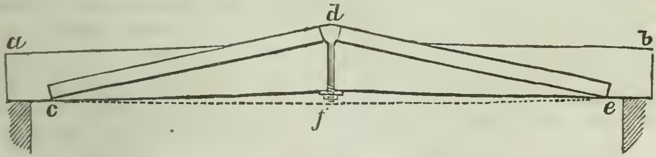
¶ METHOD OF TRUSSING GIRDERS.

The thanks of the Society were voted to ALFRED AINGER, Esq. *of Doughty Street, one of the Chairmen of the Committee of Mechanics, for the following description of a cheap and simple mode of adding to the strength of girders and other wooden beams.*

THE plan of *trussing*, which it is the object of this paper to explain, was first submitted to the Society in 1824, and several models were subjected to actual experiment, on a tolerably large scale, the results of which will be noticed in the proper place. It appeared, however, that a method of strengthening timbers, similar in principle, and not very dissimilar in detail, had been practised in Scotland, though it was very little known, and less used, in the south. Mr. Ainger's plan, not having been at that time applied to any building, was, in consequence, withdrawn: since that period the suggestion has been realized with so much success, as to render it not improbable that a statement of the economy, simplicity, and effect combined in this method might be usefully published.

The mode of trussing girders, which is exhibited in all the old books on carpentry,—which was extensively and exclusively used till within a very few years, and which is still frequently used,—consists in the addition of an arch-like arrangement of wood or metal, upon the resistance of which alone the strength of the girder is made to depend, the main timber itself forming little more than the support and the abutment of the included arch. This mode is described in fig. 1, where *a b* is the main timber, and *c d*, *d e*, are two inclined struts or braces, resisted at their lower extremities by plates of metal inserted into the timber, and which support the middle of the beam by means of the screw *king-bolt d f*, by the action of which the girder is bent upwards, or, as it is called, *cambered*, in the manner shown in the figure. When this is done, it is evident, not only that any weight laid on the girder must eventually press upon the king-bolt and the braces, but that the timber itself, on account of its bent or

Fig. 1.

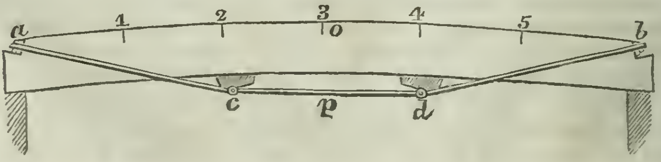


cambered form, is also exerting a great pressure on the king-bolt, which is likewise transferred to the braces. It is equally evident that, until the girder has sunk in the middle so far as to assume a straight line, it can support no part of the load, but is itself a load upon the braces: a very little consideration will serve to show the inadequacy of these to the strain thus imposed upon them. Their resistance, of course, depends upon preventing their bases *c e* from separating or spreading laterally; in preserving, that is to say, the dotted line *c e* of the same length; and this effect seems, at first sight, to be accomplished by the lower edge of the timber: it is supposed to be so in the calculations made of the strength of girders trussed in this manner. But in order that the lower edge of the girder should act the part thus assigned to it, the woody fibres at that edge must be in a state of tension, like a heavily-laden chain or rope. Those fibres are, however, in a state of compression instead of tension, inasmuch as they occupy the concave edge of the beam, which is, of course, shorter than the convex edge; the resistance to the braces must take place, therefore, higher up in the beam, perhaps nearly in the middle of its depth,—a circumstance which would alone destroy half the estimated strength of the girder.

Notwithstanding these obvious defects, this mode of trussing continued to be much employed till about the year 1816, when Mr. Barlow, among other valuable experiments, compared girders, trussed on the principle above described, with a plain piece of timber of the same size, and found the latter to be on the average not considerably weaker. Since that time, therefore, in all well-executed works, the lower ends of the braces have been connected by an iron rod in the dotted line *c e*, which may, of course, be brought to any state of tension by means of screws or keys. With this addition the truss is perfect in principle, and its strength is limited only by the strength, substance, and workmanship, of the materials employed. It is, however, difficult, and somewhat expensive to make, in an effectual manner; in consequence of which, and partly, perhaps, in consequence of ignorance of the defects of the old plan, the latter is still too frequently employed. The method proposed and adopted by Mr. Ainger is at least as economical as the old plan; and, though not so powerful as that which is composed of iron braces and a horizontal iron connecting-bar *c e*, will be found to add very greatly to the strength of the timber, and at a very small expense.

Fig. 2 is copied from a girder actually in use, 34 feet long, which supports a leaden flat, and which has not altered sensibly during the two years it has been applied. As before, *a b* is the timber, bent

Fig. 2.



upwards or cambered to about the same extent as in the former case. The trussing consists of a series of iron rods *a c d b*, pulling against iron plates notched into the timber at *a* and *b*, and connected at *c* and *d* by bolts similar to those of a suspension bridge, the rod *c d* being double, to embrace the ends of *a c* and *d b*. The rods *a c d b* form, in fact, a suspension bridge, supporting, by the bolts *c d*, the middle of the girder, the ends *a* and *b* being prevented from approaching by the opposition of the woody fibres at the upper edge of the timber. If, however, this were all, it is clear that the girder would have a defect exactly the counterpart to that described in the last case. The cambering would cause the upper fibres to be in a state of extension; they would, therefore, rather promote than resist the approach of the points *c f*, and the resistance must take place, as before, nearly in the middle of the depth. But in this case the objection is very easily and completely remedied by merely cutting notches, about one-third of the girder's depth, in its upper edge, as 1, 2, 3, 4, 5, and filling them, after the girder is bent, with thin wedges of hard wood or metal forcibly driven in. By this means the upper edge of the girder is put into the best possible state to resist, by its anti-compressive force, the tension of the iron rods, the strength of which alone limits the strength of the girder.

For calculating the size of the iron rods proper to be applied in any particular instance, the following will furnish an example:—Good wrought iron tears asunder with a force of about 28 tons on each square inch of section; but it extends sensibly with half that weight, and should not in practice be loaded with more than one-fourth, or 7 tons per square inch. The depth of a girder, such as fig. 2, may be represented by the distance from the middle of the notch 3 to the middle of the bar *c d* or from *o* to *p*: suppose this depth so measured to be 14 inches, suppose the length of the girder between the bearings to be 34 feet, and suppose it subject to a load on its centre of five tons: the requisite area of section for the iron bars in square inches would be, in that case, $\frac{204 \times 2.5}{7 \times 14} = \frac{510}{98}$, or $5\frac{1}{4}$ nearly. Here 204 is half the girder's length in inches; 2.5 is half the load on the centre in tons; 7 is the practical strength of each square inch of wrought iron in tons; and 14 is the depth of the girder, taken, as before described, in inches. If the load be uniformly distributed over the length of the beam, its effect will be equal only to half the same load placed in the centre. Five tons distributed thus, in the case just described, would give, as the requisite section for the iron bars, $\frac{204 \times 1.25}{7 \times 14} = \frac{256}{98}$, or rather more than $2\frac{1}{2}$.

In the experiments alluded to, a fir beam, 8 inches square, 12 feet long between the supports, and strengthened by iron rods one inch square, applied in the manner just described, was found to support a weight of between 4000 and 5000 pounds, being more than double what it could sustain without the trussing. A girder of the same size, trussed with iron braces as in fig. 1, and with an iron tie bar one inch square in the dotted line *c c*, exhibited no greater strength to resist fracture, though its deflexion under similar loads was, of course, less, inasmuch as the compression of iron must be less than that of fir.

I am, sir, &c. &c. A. Ainger.

A. Aikin, Esq. *Secretary, &c. &c.*

[*Trans. of Soc. for Encouragement of Arts.*

¶ *The Carpet Manufactory of Baarn, in Holland.*

Extracted from the letter of a Belgian traveller to a friend at Brussels, and translated by the latter for the Mechanics' Magazine.

"The progress of national industry is a subject as you, my friend, are aware, which is too near my heart, for me not to devote a part of the time I had to dispose of, during my short residence at Soestdyk, (in the environs of the palace of the Prince of Orange,) to visit the far-famed Royal Manufactory of Carpets, in the delightful village of Baarn, a mile and a half (English) from the palace; to which I was the more induced that I have the satisfaction to be acquainted with the Director, Mr. E. G. W. Cohen, a man of genius, and of universal knowledge.

"This manufactory presented nothing extraordinary till it became under the direction of Mr. Cohen; but since then it has attained a degree of perfection not exceeded, if equalled, by any similar establishment either at home or abroad.

"I first visited the dying house, which is furnished with a great number of immense boilers, constructed after the best plans; then the place where the colours are prepared; and next the laboratory where preparatory experiments are first made on a small scale. From these we passed to the work-shop, where all the instruments and machines, from the smallest to the largest, are constructed and repaired. Such is the diversity of objects here, that, at first sight, the visiter imagines himself transported to a repository of arts and trades, or into a vast establishment composed of many workshops united. The best turning lathes, dividing machines, chronometers, and michrometers, engage your attention; then there is a foundry, a forge, a carpenter's shop, &c. &c.; every thing, in short, necessary for constructing and keeping in order the multifarious objects used in the manufactory.

"To describe to you that manufactory itself—the carding, combing, roving, stretching, spinning, reeling, doubling, and turning machines—were an endless task; suffice it to observe, that the machinery is all constructed according to the latest improvements, and all made on the spot, yet in such high perfection as to leave but little, if any thing to desire.

"The products of the manufactory are of great variety. The principal descriptions are as follows:—

"Brussels carpets, with single and double ground and threads.

"Velvet pile, or Wilton carpets, of arabesque, half superior, superior, high superior, and imperial qualities, with single, as well as double ground, and threads.

"Smyrna or Turkey, and Persian carpets, of different qualities.

"Savonnerie carpets, which rival the richest embroidery or most elaborate painting in execution of figures, flowers, and designs.

"Kidderminster, Venice, jaspé, and cow hair carpets, rugs, staircase carpets, &c.

"Of these, and other fabrics here manufactured, the warehouse in Amsterdam contains many thousand varieties, and of all qualities, so as to suit every rank—the peasant's cot as well as the nobleman's palace.

"They showed me a carpet intended for a drawing room in the royal palace. It would be difficult to imagine any thing more beautiful produced by human labour; the elegance of the pattern, the harmony, brilliancy, and variety of the colours, were surely never surpassed. Another carpet, of a double ground, contained, I was told by the workman, forty-five colours; and I was assured that this magnificent carpet was composed of 243,000 worsted threads, alternately united and detached from each other. This carpet was purchased by the king of the Netherlands, and sent, as a valuable present, to the king of Prussia, and it now adorns one of the finest apartments of the palace in Berlin. A third masterpiece, destined for an altar piece in a church, representing the *Madonna de la Sedia*, of Raphael da Urbino, was a faithful copy from the beautiful and famous copperplate engraved by Raphael Morghen. It was entirely executed in the common weaver's loom, brought to a colossal size to produce a striking effect. This piece was made in a much more ingenious manner than the Savonnerie carpets; the latter are done on a standing chain, and the colours drawn by hand—but the former was worked entirely (with 130 colours,) in the common weaver's loom.

"Some of the Turkey, Persian, and Savonnerie carpets, are worked (*à haut lisse*,) with a perpendicular, or standing shaft, where the colours are arranged by the hand of the workman, and immediately worked in the chain by the loom.

"One of the finest inventions used in France, in manufacturing figured silk, has been here applied with admirable effect. This invention, in utility, may compete with the cotton spinning frames of Arkwright, with Bolton & Watt's improved steam engine, or with Cartwright's ingenious invention of the power loom; while with regard to the variety and multiplicity of designs it executes, it surpasses incomparably all the old methods. And yet it is but a simple machine, having neither wheels nor screws.

"It is known that in order to produce the figure in any weaving, the threads must be successively drawn in a certain order till finished; and it is this which has given rise to the operation called drawing, which consists in pulling up, after each throw of the shuttle, in a prescribed order, one of the threads necessary in the formation of the figure; an operation usually done by apprentice boys. With the machine which I have just mentioned, all the inconveniences of the drawing not only by hand are avoided, but many other advantages are obtained, which gives the highest perfection to this art, and such as it never could have reached by the old method. .

"An establishment of so much importance was worthy the patronage of the government, and it has accordingly honoured it with its special protection. The director, who is a member of different royal societies of arts and sciences, obtained at the exhibition of Ghent in Flanders, in 1820, the silver medal. At the last exhibition at Haarlem, in 1825, he also received the silver medal; besides various medals for several inventions and improvements in the manufacturing of cards for wool and cotton. The royal society of Haarlem for domestic economy, assigned to the director of this fine establishment of national industry, its medal of honour; and at the exhibitions both of Ghent and Haarlem, the king purchased many of the principal specimens produced by the manufactory."

Plan for giving buoyancy to Chain Cables. By John Pole, Commander H. M. S. Maidstone.

The advantage of a hemp cable over a chain one consists in its yielding more readily. Whenever a chain cable forms a curve it requires a great power to draw that curve to a straight line. In moderate depth of water, the curve formed by the chain is very considerable; but in very shoal water, as Table Bay, where ships anchor in four fathoms, and lay nearly with 100 fathoms cable out, the cable is then nearly horizontal, and supported in a straight line by the ground; consequently when the ship receives a blow from the sea it can yield little or nothing, and it snaps. Now, I propose that in very shoal water, as the cable cannot form a natural curve, to make an artificial one, and I think in a very simple and efficient manner. Every ship has always a few empty water casks at hand; four or five good sized casks, would be quite enough, and any thing of a buoyant nature might be employed in aid of them. These casks should be kept slung with a hook and thimble in the lower part of the slings, and when coming to an anchor in moderate weather, I should veer out a moderate quantity of cable, and when it comes on to blow fresh, as I veered I would hook on a cask at every ten or fifteen fathoms, according to the size of the cask and weight of the cable. These casks, from their buoyancy, would festoon the cable when it became slack, and when the ship was forced astern again by a blow from the sea, she would have to pull each of these casks down, and also astern, as every cask would be farther from the anchor with a straight cable than when festooned. In Table Bay there is an under tow setting out, and there is the same, I believe, in all bays when the wind blows strong into them; which under tow would also make a resistance to the casks, as the vessel drew taut her cable, and the ship would then be regularly eased to her anchor, and no sudden shock could be felt. I think a table might be computed to show how much buoyancy it would require for a certain length of cable in a certain depth of water to give the most desirable curve; and in fact I think you may give any elasticity you like to a chain cable by this simple method.

These casks, it must be recollected, will be below the influence of the sea, and cannot be injured by it, and the only strain they will feel, will arise from their own buoyancy. After the gale was over, you would, of course, heave in to your usual length of cable, and take the casks off.

Merchant ships find the advantage of chain cables in so many ways, and there are so few objections to them beyond their liability to snap in shoal, and also in very deep water, that if any simple method could be devised to do away with these objections, there can be no question of its great utility. Whether festooning the cable, as I propose, in very shoal water, and in very deep water giving the cable a certain degree of buoyancy to relieve the ship, will have that desired effect, I will leave others to judge.

[*Mech. Mag.*

¶ *First Report of the Proceedings of the British Association for the Advancement of Science, assembled at York.*

[Continued from p. 9.]

The same views are, perhaps, still more happily presented in the following paragraphs, which we really hope will go far to do away with the erroneous impression, still existing in some quarters, of an intentional interference on the part of the new institution with other scientific bodies.

"But there is a defect in these separate societies, in respect to their own immediate objects, which I am sure no member of them would wish to dissemble, and which arises from the narrow basis on which they are of necessity built. It is not only, that the constant converse of men, who, to borrow the expression of Goldsmith, have often travelled over each other's minds, is not half so effectual in striking out great and unexpected lights, as the occasional intercourse of those who have studied nature at a distance from each other, under various circumstances, and in different views; but it is also, gentlemen, that none of our existing societies is able to concentrate the scattered forces even of its own science; they do not know, much less can they connect or employ, that extensive and growing body of humble labourers who are ready whenever they shall be called upon, to render their assistance."

"What numberless suggestions, what a crowd of valuable but abortive hints are continually floating in the thoughts of philosophers, for the pursuit of which time is wanting to themselves! Now I say, gentlemen, that we have among us, scattered through the country, men willing to adopt these unexecuted hints, as they arise out of the profound and varied meditations of more experienced minds, men not incapable of surveying with accuracy a limited district, though they may not pretend to draw the general outline of the map, or fill up the whole of its details. Many such there are who only wait for instructions, and who require no other stimulus than that of being invited, to render the most essential service to researches and calculations of the highest order; and it is upon this ground especially that we venture to pronounce an institution wanting, which shall not hesitate to make such invitations and to offer such instructions; it is upon this ground that if we now propose to revive in the nineteenth century a plan devised two centuries ago, we see a difference, gentlemen, in the probability of success. Scientific knowledge has of late years been more largely infused into the education of every class of society, and the time seems to be arrived for taking advantage of the intellectual improvement of the nation. Let philosophy at length come forth and show herself in public; let her hold her court in different parts of her dominions, and you will see her surrounded by loyal retainers, who will derive new light and zeal from her presence, and contribute to extend her power on every side.

"Much, indeed, is not to be gained in the more recondite subjects of investigation from the first essays of inexpert inquirers; but let the number of those inquirers only be increased, collect around you, gentlemen, a school fired with a zeal for truth, confess to them how little you know compared with what remains to be known, apprize them that there is not a subject to which they can apply themselves where new materials are not wanted to advance the fabric or secure the foundations, let them see that the more multiplied have been your discoveries, the more additional openings to discovery have appeared; and if you will then draw the pencil line of what is, and what is not, made out in every science, if you will indicate to them those prominent points and *inlets* of inquiry which bid fair to lead to promising results; if you will thus put before them right subjects, and at the same time suggest the right method of treating those subjects; whatever more may be wanting to accurate and successful investigation, natural sagacity and a longer experience will easily supply to men possessing only common abilities, and walking in the common paths of life."

We feel that we should discharge but imperfectly our duty in disseminating as widely as possible the objects of this report, did we not transfer to our pages the recommendations of the sub-committees of the association upon different branches of science, who are in fact the active organs of the association, forwarding its scientific objects, and providing the intellectual occupation of its successive meetings. [*Brewster's Journal.*

¶ *On the use of Heated Air and Uncoked Coal in the Smelting of Iron Ores.*

The journals have lately announced the discovery in France of a method of smelting iron ore with billets of wood uncoked, from which a great saving of expense is anticipated. This discovery will prove of high value to the iron smelters in foreign countries, especially in the north of Europe. But to the British smelters it is vastly inferior in importance to the process now employed at the Clyde Iron Works, by which iron of an excellent quality is obtained at once, and in much larger quantity than formerly, by the employment of raw uncoked coal. The agent in this remarkable amelioration of the smelting process is heated air, with which the blast in the furnace is kept up instead of the cold air hitherto propelled into the furnace. The iron, when withdrawn, is much more fluid than when smelted by the old process, and in this respect has much resemblance to the Silesian iron of the first fusion. The value of this happy application, in an economical point of view, may be seen from the following circular drawn up by the patentee.

Comparative view of the quantity of materials required at Clyde Iron Works to smelt a ton of foundry pig iron, and of the quantity of foundry pig iron smelted from each furnace weekly:

	Coals in tons of 20 cwt., each cwt. 112 lbs.	Iron-stone.	Lime-stone.	Weekly produce in pig iron.
1. With an air not heated and coke, - -	7 tons	3¼	15 cwt.	45 tons.
2. With air heated and coke, - - - - -	4¾	3¼	10	60
3. With air heated and coals not coked, - -	2¼	3¼	7½	65

Notes.—1st. To the coals stated in the 2d and 3d line, there will fall to be added 5 cwt. of small coals, that being required to heat the air.

2nd. The expense of the apparatus for applying the heated air will be from £200 to £300 per furnace.

3d. No coals are now coked at Clyde Iron Works; at all the three furnaces the iron is smelted with coals.

4th. The three furnaces are blown by a double powered steam engine, with a steam cylinder forty inches in diameter, and a blowing cylinder eighty inches in diameter, which compresses the air so as to carry two and a half pounds per square inch. There are two tuyeres to each furnace. The muzzles of the blow pipes are three and one-eighth inches in diameter.

5th. The air is heated to upwards of 600° of Fah. It will melt lead at the distance of three inches from the orifice through which it issues from the pipe.

[*Brewster's Jour. of Sci. No.* 12, *April*, 1832.

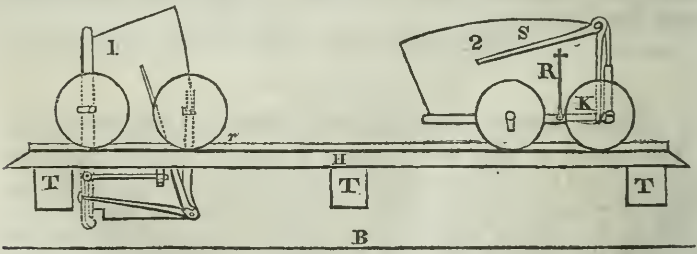
On the Manufacture of Sulphuric Ether.—C. Wittstock.

The remark of MM. Fourcroy and Vauquelin, that the sulphuric acid employed in the fabrication of ether undergoes very little change, led to the conclusion that ether would be formed as long as there was a fresh supply of alcohol to the acid. This supposition was confirmed by the experiments of M. Gay Lussac; and since then the fabrication of ether has been considerably improved by MM. Boullay, Geizer, and others. I have for some time employed the following method; and as I am disposed to consider it more simple and less expensive than any other, a short description of it may perhaps be acceptable to the reader.

A mixture of nine parts of sulphuric acid, (s. g. 1.84—1.85,) and five parts of alcohol, (s. g. 0.835,) are put into a green glass retort of one foot in diameter, with a glass tube inserted at its upper part. This tube is four lines in diameter, and bent at a right angle; the shorter arm, which at its extremity, has only one line in diameter, is plunged one inch deep in the mixture; the longer arm, of about three or four feet length, with a cock near its further end, leads into a bottle, with alcohol. The receiver consists of a refrigerator, viz. a wooden tube filled with water, by which the distilled ether is kept cool, and two copper vessels, the one within the other, so that there is a distance of about two inches between their sides. The neck of the retort leads into the intermediate space between the two copper vessels, which is thus filled with the distilled liquid, and from which the liquid may flow off by another tube. The apparatus is used in the following manner:—When the mixture is boiling, the cock of the glass tube is opened, and the supply of alcohol thus kept up, so that the quantity of liquid in the retort remains always the same; this is continued until eight times the original quantity of alcohol has been used, which will be the case in about twenty hours, if the original mixture consisted of 25 lbs. of sulphuric acid, and 14 lbs. of alcohol. The first rectification of the ether thus obtained yields about its third of ether of .725 sp. gr. which may of course be considerably increased by repeated rectifications, besides about twenty to twenty-five per cent. of alcohol are regained, which may be subsequently used again, particularly for the supply of alcohol to the mixture.

Of 124 lbs. of alcohol of 0.835 sp. gr., 22 lbs. were regained; the quantity of pure ether of 0.720 to 0.725 sp. gr. at 14° R. amounted to 59 lbs., and of sulphuric acid 25 lbs. were used. The expenses of fuel, apparatus, attendance, &c. does not raise the price of the ether to more than twice that of its weight of alcohol.*

¶ *Improved Excavator's Wagon.*



Sir,—The accompanying sketches represent an improved sort of wagon, which was used for removing the earth at the excavation of the new entrance to the London Docks. It is a well known fact, that if clay is mixed with water and a little sand, it forms so compact and cohesive a mass, that when carted to a distance of two or three hundred yards, it is next to impossible to uncart it without the help of pickaxe and shovel. The soil to be excavated in the present instance being very much of this description, it was the general opinion that the ordinary kind of excavator's wagon would be of little use; and being in the employment of the contractor for the work, I therefore set about contriving such an alteration in the construction as might meet the difficulty of the case. After several trials, with different models, the one of which I now send you a description was found the most suitable. We had a good many wagons constructed on this plan; and I was very happy to find, that when the mode of using them came to be understood by the workmen, they answered our purpose admirably.

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* Extracted from Poggendorff's Ann., Band xx. St. 2, page 461.

Description.

Fig. 1 is a side-view of the wagon when emptying. B, shows the line of the barge at high-water. TTT, are whole timbers. H, are half-timbers on each side of the wagon to secure the iron rail, *r*. The distances from TT, and also between the rails, are left open, to allow the tail of the wagon to drop through, as in fig. 1.

Fig. 2 shows the method of securing the tail-board at top and bottom. At J is a joint, to allow the wheels to run out, and at K a catch to secure the axle; *s*, is a strap, bolted to the side to secure the tail-board at the top.

The course followed on emptying the wagons was to push them forward to one of the timbers, as at T, and then to allow the bottom to slide down the timber gently. A man on each side then pulled up the rods, as at R, which lowered the catch K, when immediately the wheels went out, down went the wagon, and the earth dropped out. Nine times out of ten the clayey mass went down into the barge as solid as if it never had been dug. I had almost forgotten to add, that the wagons were about four inches wider at the tail than at the head. The drawings show the axles bent, but they were not all so; the more bent, however, the axles are, the more easily the wagons are managed.

Yours, &c. J. Walker.

[*Mech. Mag.*

The effectual consumption of Coal Smoke, and a mode of erecting Fire-proof Dwellings, without the use of Iron Beams.

To the Editor of the London Morning Chronicle.

Sir,—In your paper of to-day I observe a paragraph which goes to prove, from M. D'Arcet's observation, that the air of the metropolis is contaminated by sulphuric acid. This will always be more or less the case while open fires are employed; but a description of furnace (Witty's,) has recently been invented, which, in all close fire-places, such as stoves for cooking by ovens, or by hot plates, in the French manner for heating rooms; or furnaces for heating water, producing steam, &c.; in short, in any case excepting where fires in open grates are indispensable, completely burns the smoke. So many inventions for this purpose have been produced and failed, or have acted only partially, that I should have hesitated to mention the present one, if I could not refer your readers to Lee's Nursery, Hammersmith, and Henderson's Nursery, Edgware road, where Witty's furnaces may be seen in operation, and where they will be found completely to verify my assertion, by burning the whole of the smoke produced from the fuel. Were these furnaces used in all cases of close fires in the metropolis, it is evident that the quantity of sulphuric acid in the atmosphere would be materially diminished.

But there is a great ulterior advantage which will, sooner or later, result from these furnaces, and which their inventor probably never contemplated. That is, that every family employing one of them for heating a room, for boiling water, for close cooking, for heating a green-house, or for any similar purpose, may produce in them as much coke from common coal as will serve to supply their open fires, and thus these also will produce no smoke, not even when first lighted. Here then is a very simple, economical, and effectual mode, alike applicable to rich and poor, of getting rid entirely of the coal smoke of the metropolis, and of every other town in the empire. Here also are the means suggested of putting an end to climbing boys and smoky chimneys.

Supposing, however, that there were some private or poor families who did not, or could not, afford to prepare their own coke, or who did not use a close fire sufficiently often to prepare enough, there would, no doubt, be others who might prepare more than enough, and sell it; because it is proved that in this preparation 30 per cent. of the fuel is saved which in open fires and common furnaces is lost.

I hope that when government have their more weighty matters arranged, they will appoint a committee to examine how far it may be adviseable to compel the use of this invention, or preclude the use of all coal not coked. This would render the air of our cities and towns as free from smoke as that of the towns on the continent.

While on the subject of general improvement, I may mention another invention, which I consider of very great importance, viz. a mode of building fire-proof houses of any size without the use of iron or any other metal, as durable as stone or brick, and cheaper than buildings composed of the usual materials.

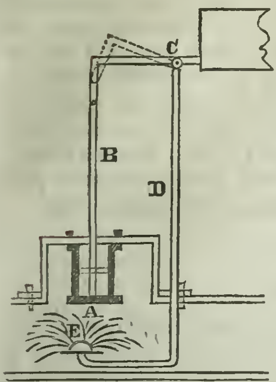
The inventor is Mr. Frost, 6, Bankside, Southwark, near the bridge, where a small house, illustrative of his invention, may be seen, or at least was seen there by me some months ago.

I enclose proofs of some paragraphs which I had prepared on both these inventions for the Gardiner's Magazine, and for an intended work on Labourer's Cottages, which you may use, or not, as you please.

I am, Sir, your most obedient servant,
J. C. Loudon.

Bayswater, January 19, 1832.

Quick-acting Safety-Valve for Steam Boilers.



Sir,—Having had frequent occasion to observe a repugnance to the employment of steam for heating buildings, &c., on account of the risk of accidents from explosion; and as many accidents have actually occurred from this cause, I send you a description of a quick-acting safety apparatus, which I shall be glad to see inserted in your valuable publication.

Yours, &c. Dunbar.

London, Feb. 24, 1832.

Explanation of the Engraving.

When the steam issuing from the boiler, through negligence or other means, gets above any required pressure, (which may be regulated by the loading of the piston,) it acts more or less according to its force upon the piston A, which raises the rod B, and opens the cock C; the water then flows from the cock through the pipe D, and is dispersed in a shower by the rose E fixed on its end, which causes an immediate condensation. The condensed water flows into the boiler, and causes a reduction of temperature. The overplus of water which flows into the boiler, may be let out by means of a float connected with a cock.

This apparatus may be fixed in any convenient part of the piping, by screwing the box on to the pipe, as shown in the sketch. And it is not subject to sticking as the common valves are, (of which there was lately a melancholy instance at Newcastle,) as it will be almost continually on the *qui vive.* D.

[*Mech. Mag.*

¶ *Steam-Boiler Explosion.*

On Thursday, the 22nd of March, the extensive calender house of Messrs. Goodier and Co. of Manchester, was almost entirely demolished by the explosion of a steam-boiler, five persons killed, and many others severely wounded. On the forenoon of that day, the engineer discovered that the eccentric motion which worked the steam-valves had sustained some injury; a millwright was set to repair it; but as it was expected the repair would be completed in the course of the afternoon, moderate fires were kept under the boilers, and the steam kept up. The works were driven principally by an engine of 32-horse power, not a high-pressure one, but a condensing-engine of the best kind, made by Boulton and Watt; and it was worked at a pressure never exceeding 12 lbs. on the square inch. It was supplied with steam from two twenty horse boilers, which were placed side by side transversely across the cellar of the building. The safety valve is stated to have been five inches in diameter, and to have been loaded with 224 lbs. being about ten pounds to the square inch. But it seems there were no safety valves on the boilers themselves, but one upon a large pipe which conveyed the steam to the cylinder. Between that pipe and the boiler were stop cocks, so that each boiler could at pleasure be shut off from the pipe. It is supposed that one or both of the boilers had been thus shut off, for the convenience of making the repairs. If so, the steam could not act upon the safety valve, and the pressure becoming too great, an explosion was the necessary consequence. In 1828, an explosion took place from this very cause at the factory of Mr. Thomas Kearsley, at Tryldesley, by which ten persons were killed, and great part of a new and extensive building demolished. [*Manchester Paper.*

Manufacture of Salt.

Sir,—I beg leave to intrude upon your valuable columns, by presenting your readers with some observations on the manufacture of salt, part of which I have transcribed from a French work, written by M. Berthier.

The salt works at Moutiers, (in the department of Mont-Blanc,) have four graduation houses, with faggots in the usual manner, and a fifth with rope: which method was invented some time back, by Chevalier Dubuet. These buildings are erected in a narrow pass into a valley. The rope graduation house is built in the form of a crescent, in order to favour the action of the wind: it is ninety yards long, of which only seventy are occupied by the ropes. The top of the building contains 259 wooden channels, thirteen yards long and five inches wide, and having the same distance between them. Each of these channels is furnished with twenty-three endless ropes, 0.007 to 0.008 metres (.3 inch) diameter, which pass through holes made in the channels, and round pulleys fixed to the floor of the building. As each of these endless ropes is 8.28 met. long, the building took upwards of 100,000 met. (sixty miles) of rope, when it was originally constructed. The salt water is raised to the top of the building by an endless chain of buckets.

The salt water is first passed twice through two common graduating houses, with faggots, and then the two portions being united together, the liquid is passed seven times, or even oftener, through the third, from whençe they pass to the fourth. The remainder of the process differs according to the weather.

During the fine season, which lasts three or four months, the liquid is passed from the fourth house to the boilers, and from thence when it boils to the rope graduating house, where it is repeatedly raised, until the greater part of the salt is deposited upon the ropes, which in very fine weather takes from twelve to sixteen hours. In general twenty-seven boilings take forty-five days.

The cords are then coated with common salt, so as to be sometimes 0.06 (2.3 in.) in diameter; this salt is got off by a cross piece of wood, armed with iron plates, being raised to the top of the building, and the cords pulled alternately, so as to strike the salt against the plates. In the bad season the water is slowly evaporated in the boilers, of which there are four, all of the same size; they are from between seven and eight metres long, five and six broad, and 0.5 met. (19.6 in.) deep.

Yours, &c.
Oct. 21, 1831. H. B. ANDREWS.
[*Mech. Mag.*

Œnometer, or Alcohometer. By M. Emile Tabarie.

This instrument is intended to supply the manufacturer with the means of ascertaining the quantity of spirit in any vinous liquid. The principle consists in boiling the wine, for instance, in the open air, allowing the alcohol to escape, and making up the bulk of the residue by the addition of pure water. The difference between the density of this mixture and the original liquid indicates the quantity of alcohol which was present. The apparatus consists of a small boiler heated by a spirit lamp; a horizontal cross bar near the bottom, when left uncovered by the liquid, indicates when the ebullition has proceeded so far as to insure dissipation of all the alcohol. The densities before and after ebullition are ascertained by a hydrometer with a double scale. For correction of temperature, a thermometer with double scale is used, one scale being the centigrade, and the other a peculiar division, intended to simplify the operation. Tables accompany the instrument. The whole is intended for the distillers of the centre of France, and costs about forty francs.

[*Ann. de Chimie, xlv.* 222.

Engraving in Stereotype.

A substitute for wood engraving has lately been devised by a young artist, which, if half the sanguine expectations of its inventor should ever be realized, will totally supersede the present method. The process, the idea of which has evidently been taken from the stereotyping of letterpress, is, as far as hitherto developed, as follows:—A smooth and level plate of metal is covered with a thickness equal to that of the projecting part of type of any ductile composition which will bear heat; what the inventor proposes to use he does not divulge, but it is believed that many sorts of potter's clay will answer the purpose. While this is in a soft state, the design is, as it were, etched with a sharp instrument, care being taken that every line shall penetrate through the layer of composition to the surface of the plate. The great advantages here are, that the engraver has a much more easily worked material than boxwood to operate upon; that the design is cut *into* the material, as in copper-plate engraving, instead of having to be left in high relief, which is an elaborate and dilatory process; and that it is executed without the necessity of *reversing the design*, a point of great importance, especially where letters and inscriptions are required; these, of course, had always to be cut the backward way; by this method they are cut just the same way as they are to appear finally upon the paper. When this portion of the process is finished, all that remains is to harden the composition, and take off a plate, or any number of plates, in stereotype metal, in the same way as if it were the plaster impression from a page of letter-press. These, of course, are to be printed from in the usual manner. Should the project succeed, the cost of engravings of the kind will be very greatly reduced. [*Mech. Mag.*

On a new Anemometer.—By Hugh Hamell.

To the Editors of the Philosophical Magazine and Annals.

Gentlemen,

Mr. Stevenson in his account of the erection of the Bell Rock light-house observes, " We cannot enough regret the want of an efficient anemometer, or instrument for measuring the force of the wind; indeed we hardly know any desideratum of more universal interest." It does not appear that this is yet supplied: and when we consider the many very eminent men who have directed their attention to this subject, and find nevertheless that they have not succeeded in producing an instrument at once ready, accurate, and sensible, it must be concluded that considerable difficulty lies in the way. And though I will not presume to say that I have completely overcome it, yet it appears to me that the instrument which I now propose possesses advantages over any other anemometer that I have seen or read of.

Before describing the instrument, I wish to observe that all the anemometers I am acquainted with are founded on one or other of these two principles: the deflection of a pendulous weight, or of a falling body, from the perpendicular; or the difference in elevation between the two columns of fluid in an inverted siphon. Of this last kind, the differential barometer of the late Dr. Wollaston, surpasses in sensibility to an indefinite degree, all others of the kind,—an invention worthy of the accurate and comprehensive mind of that lamented philosopher; but it is to be apprehended that in many cases it cannot be easily applied to practice.* It is the other principle, that of a pendulous weight deflected, that I make use of; and I shall now proceed to the description of the instrument I propose.

Imagine two pieces, which I shall call bars, like the two ruler pieces of the common parallel rule, and attached to each other by two joints in a similar manner; the joints being constructed so as to play with scarcely any friction. Let these bars be placed, in contact, with the plane of the joints perpendicular to the horizon; it is clear that the weight of the lower bar will cause it to separate from the upper; and the joints to arrange themselves perpendicular to the horizon. To one end of the lower bar (that end which is to be presented to the wind,) let a plane of given magnitude be affixed, perpendicular to that bar. Now, to use the instrument, let this plane be placed perpendicular to the wind, the upper bar being in a fixed position; the two bars being separated to their greatest distance, and the joints of course at right angles to the bars, and perpendicular to the horizon. The impulse of the wind acts as a force on the plane, and causes it to recede; but in consequence of the two connecting links, and the two parallel bars, it must still preserve its parallelism to its first position, while it will continue to recede; the links turning round their centres until they have reached such an angle from the perpendicular as shall produce an equilibrium between the impulse of the wind on the plane and the weight of the lower bar with its appendages, now supported by the links in an oblique position; the angle by which the links deviate from the perpendicular to be measured on a circular arc attached to the fixed bar. As the lower bar, plane, and links ought to be made as light as is consistent with the required strength, and further, perhaps, their common centre of gravity to be brought by counterpoise into the line joining the upper centres of the links, it will be seen that the most moderate breeze will cause the two bars to collapse, or nearly so. There must, therefore, be a series of weights, one or more of which must be suspended to the lower bar according to the strength of the wind, so as to cause the equilibrium to take place with the links at an angle not greater than 45°, from their quiescent or perpendicular position.

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* A notice of Dr. Wollaston's paper on his Differential Barometer, will be found in this Journal, p. 349, vol. iv.

Now the weight deflected is known, the surface of the plane is known, and also the angle passed through by the links; hence, by an easy calculation, the force acting on the surface of the plane is readily deduced; and from this the velocity of the wind, by means of the tables published of the relation between that and the force.

I hope I have made my ideas sufficiently clear without encumbering your valuable pages with a sketch, or with the details of construction. And for the same reason I shall not make any comparisons between this and other anemometers, except that I conceive the suspended sphere, as it always presents an equal and similar surface to the wind, makes a very simple anemometer, and by counterpoising as I have done, it might be rendered sensible to almost any degree; but I think it is liable to objections, from which I believe that which I propose to be free.

I shall feel obliged if you will give insertion to this paper in your extensively read and valuable journal; my object being to assist in attaining that desideratum which would be of such advantage in many cases of practical mechanics, as well as in meteorological observations.

I am, gentlemen, your obedient servant,
Dublin, Oct. 28, 1831. HUGH HAMELL.

[*Phil. Mag.*

Indian Arts and Manufactures.

No. II.*

THE PALM OR TODDY TREE.

The most extensively useful tree in India, and probably in the world, is the palm tree. In India I have only observed four species. 1st. the *cocos nucifera*, or cocoa-nut tree, which is common all along the western coast, near the sea, as far north as Surat—some are found even more to the northward. 2ndly. the *bonassus flabelliformis*, which the natives call the "tar," is also in great numbers as far up as Cutch; I have myself seen it 130 miles from the sea; but I believe it is to be found at a much greater distance. 3dly. the *phœnix dactylifera*, or date palm, is common all the way up the coast from Cape Cormorin to Cutch, and is found several miles inland. 4thly. the *areca*, which is cultivated only on account of the nut, is found in gardens in Bombay, Baroda, &c. &c.

Every part of the cocoa-nut tree is used for some purpose or other. The nut is well known, and is not only an indispensable ingredient in every article of native cookery, curries, pilaws, &c.: but yields by expression (when dried,) an oil which is superior to linseed oil for burning, both as having less smell, and producing in the combustion no visible smoke. The natives also anoint themseves all over with it. The shells of the cocoa-nut, when burnt to charcoal and pounded, are used in paint, like lamp-black in England. The hard, or inner shell of the nut, forms their drinking cups, as well as a material part of their smoaking apparatus: half full of water, with two hollow bamboos fitted into as many holes bored in it, and an earthen "chilum" at the top full of tobacco, it forms their "hukka," a companion which no native would willingly be without. The outer shell consists of a stringy substance called "coir," pronounced "kyar." It is equal to horse hair for stuffing mattresses, pillows, &c., and when formed into ropes is in some respects equal, and in others superior to hempen cordage, being much lighter, more elastic, and not so likely to be damaged by wet. The leaves of this, as well as of the "tar" tree, when dried and platted, are called "cajan," and are used for laying under the thatch of houses, by which a much smaller quantity of grass will suffice. They are sometimes used without grass, but then require to be renewed annually. The body of the tree is of much service, when hollowed out, as a course to conduct water across a road, or "nulla" (the dry bed of a rivulet, or mountain torrent,) for the purpose of irrigating lands at a distance from the well, or tank, from whence the water is drawn. But to the owner of the property the most valuable part of the palm tree is the toddy. The best and sweetest is extracted from the date palm; the cocoa-nut tree yields the next best, which, however, as well as that obtained from the "tar," or fan-leaf palm, (as I believe it is called,) is more abundant than the former; it is never taken from the areca. This liquor is thus obtained. At sunset, a man of the Bundarree caste of Hindoos mounts the tree with two or three earthen pots, called "chatty," capable of containing about a gallon each, tied to his waist, and a large knife, shaped like a sickle, in his hand. He is assisted in his mounting by two circular pieces of rope, large enough to extend round (when doubled) two-thirds of the circumference of the tree, one of them being attached to his hand, and the other to his feet, by which means he ascends the tree without the assistance of his knees. Some of these trees, I should guess, are above 100 feet in height; and one man has twice daily to ascend and descend some fourteen or fifteen, or even more of them. He cuts off one of the leaves of the tree when the stalk is about two inches in diameter, and ties on one of these chatty pots. If the leaf has before been cut off for the extraction of the toddy, he only removes half an inch from the end of the stalk, whence the toddy again exudes. After having thus fixed his pots, sometimes three or four on one tree, he descends the tree, and mounts as many more as may be necessary. In the morning, at daybreak, he returns to the trees, takes down the pots, which are half full of liquor, and places others in their stead. This liquor, which, when fresh from the tree, is called "neera," is as transparent as water, and of a pleasant, sweet taste; but immediately the sun rises, it begins to ferment, after which it becomes of a milky colour, tart, and sourish—it is then termed "taree," whence our corruption, toddy. The fermentation is soon at its height, and in that state it is used by our bakers as a substitute for yest to raise the dough. A great deal of the taree is drank by natives, and is of an intoxicating quality; but by far the greater portion is made into vinegar, or distilled into arrack. The European soldiers, and even warrant officers, who are used to it, prefer arrack to brandy or rum, though it is not relished by Europeans on their first arrival. Besides arrack, there is another species of distilled liquor, called "mowrah," which is made from the flowers of a tree of the same name, which grows to about the size of a beech tree. As I have not had an opportunity of examining it, I do not know to what class it belongs, or what its English or Linnæan name may be. The flowers, when dried, have much the appearance of a fig, but are only about the size of a raisin; and their taste is somewhat like the latter, with a bitter flavour exactly like hops; and I have no doubt that when we shall have proceeded to so high a degree of refinement in this country as to brew our own "Hodgson," that they will fully answer every purpose of the latter.

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* The great distance of the writer of these valuable papers from England, will account for his communications being so "far between." No. 1 appeared in our 14th vol. p. 387. We need not say that an early continuation of the series will be most acceptable.—*Editor Mech. Mag.*

BENGEIN.

Goozerat, Oct. 28, 1830.

[*Mech. Mag.*

On the Discharge of a Jet of Water under Mercury.

By R. W. Fox, Esq.

Having observed that a communication of mine "on the discharge of a jet of water under water," inserted in No. 47 of the Philosophical Magazine, has been noticed in the last number of the Journal of the Royal Institution,* I will take this opportunity of mentioning, that where a jet of water is discharged under mercury, the results are the same, under a given force, as when it takes place in water, or air, the quantity discharged being in all cases the same, in the same time.

Hence, it appears that the force with which a moving or spouting fluid recoils is not affected by the surrounding medium, however rare or dense it may be: and thus we may understand why the attempts which have been made to propel vessels by forcing water through them against water, have not proved advantageous.

The well known fact that large rivers penetrate, in a direct course, far into the ocean, notwithstanding its agitation by tides and currents, is somewhat analogous; and were it not for this remarkable degree of mobility in water, the sediment, which is now mostly deposited at a considerable distance in the sea, would accumulate near the mouths of rivers, and tend to divert them from their course.

Whilst making my experiments on the jet of water, I noticed that when sand was dropped into the water near the orifice from which the jet issued, it was drawn laterally toward the hole, till it distinctly appeared to enter it, but it was in fact only an optical deception, the grains of sand being carried away by the jet as soon as they came in contact with it, with such great velocity as to be perfectly invisible. [*Jour. Roy. Inst.*

Tanning of Leather by Grape Marc.

A medical man of the neighbourhood of Narbonne has announced that the marc of grapes, after being distilled for the purpose of separating the alcohol, is an important assistant to oak bark, in the tanning process. After preparing skins in the usual manner, he placed them in the pits with the marc, in the place of bark. In thirty-five or forty days the tanning was finished. The expected advantages are, 1, shorter time; 2, reduction of the price of oak bark; 3, a more agreeable odour of the leather than that given by oak bark; 4, greater strength in the leather. [*Recueil Industrielle.*

Planting Potatoes whole.

A correspondent of the Gardener's Magazine, No. xxxv. for December, writing upon the above question, agrees with Mr. T. A. Knight in recommending that they should be planted whole: and adds, "as a testimony, I will state an experiment of mine in 1828. I planted four plants containing two eyes to each; four, the crowns containing perhaps five or six eyes each; four small whole potatoes, (what are here termed chats;) four large whole ones, (or what are termed ware potatoes.) Now for the weight of the produce of each kind: the produce of the first four roots weighed eight pounds; that of the second four, eleven pounds; that of the third four, fifteen pounds; that of the fourth four, sixteen pounds. I think this will make clear to any one, that the reverse of what is generally followed ought to be practised; namely, to plant crowns or whole potatoes in lieu of a plant with two eyes. This is even the second trial I have made, and found it the same; but I was not so particular in the first experiment as in the second, having determined by my eye, the difference was so obvious. I think this of the greatest importance to the agriculturist. If it hold good for an acre, what a difference in the produce! The object of a little extra seed bears no comparison to the extra produce; and besides, the labour of cutting is saved.

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* See vol. viii. p. 69, of this Journal.

[*Rep. Pat. Inv.*

Pure Oil for Chronometers.

Put about one gallon of good olive oil into a cast iron vessel capable of holding two gallons; place it for one hour over a slow clear fire, keeping a thermometer suspended in it; and when the temperature rises to 220° check the heat, never allowing it to exceed 230°, nor descend below 212°; at the end of the hour the whole of the water and acetic acid will be evaporated. The oil is then to be exposed to a temperature of 30° to 36° for two or three days, till a considerable portion of it is congealed, and while in this state the whole is to be poured on a muslin filter, to allow the fluid portion to run through. This fluid portion is then to be filtered once, or oftener, through newly prepared animal charcoal, grossly powdered, or rather broken, and placed on bibulous paper, in a wire frame, within a funnel; by this operation any rancidity that is present will be entirely removed, and the oil rendered perfectly bright and colourless. This process has been employed for several years with great success by Mr. Henry Wilkinson, of Pall Mall, and Messrs. Baraud and Sons, of Cornhill, who both agree in representing it as superior to every other mode of purification hitherto known. Mr. Wilkinson states that he does "not think it possible to render oil purer or better qualified for the required purposes, as no extraneous substance is introduced which can in the slightest degree injure its quality."

[*Mech. Mag.*

¶ *On the Detection of the Traces of Writing Fraudulently Effaced.*

Professor Gazziri, of Florence, having been frequently appointed by the tribunals to give professional evidence on trials of this nature instituted experiments on the subject, which, by showing him the possibility of removing not only the ink, but also the materials employed in its removal, proving that cases might arise when the fraud could not be detected in any other manner than by examining the condition of the paper or other materials written upon. For this purpose optical means were tried in vain, and immersion in water did not show such a difference in the absorptive power of the written and unwritten parts, as happen in the employment of certain sympathetic inks; but on exposure of the suspected paper to a moderate fire, the paper, which in consequence of the corrosive effects of the ink, was in those parts altered in its nature, was unequally acted on by the process of carbonization, and thus the number and length of the lines, and often the whole of the erased portion, were distinctly revealed. [*First Report of British Asso. for Advanc. of Science.*

Meteorological Observations for June, 1832.

Moon.	Days.	Therm.		Barometer.		Dew point	Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise	2 P.M.	Sun rise.	2 P.M.		Direction.	Force.		
				Inches	Inches.				Inches.	
	1	52°	73°	29.70	29.75	45	NW.	Moderate.		Clear day.
	2	50	80	.73	.65	49	NE. W.	do.	.26	Clear day.
	3	56	54	.50	.45	62	E.	do.		Cloudy—rain.
	4	48	59	.50	.60	53	E. S.	do.	.35	Cloudy day.
☽	5	49	52	.60	.65	54	SE.	do.		Rain.
	6	48	68	.70	.70	53	W.	do.	.04	Lightly cl'dy: flying cl'ds.
	7	54	69	.70	.75	55	W. E.	do.		Cloudy—light shower.
	8	50	74	.75	.80	57	E. SE.	do.	.03	Fog—clear.
	9	51	74	.90	.90	56	NE. SW.	do.		Foggy: clear: shower n't.
	10	56	78	.90	.90	60	SW.	do.		Cloudy—flying clouds.
	11	60	89	.90	.90	66	SE.'W.	Breeze.		Fog—clear.
	12	70	80	30.00	30.00	65	S.	do.		Clear day.
🌕	13	58	81	.00	29.90	63	E. S.	Calm.		Cloudy—clear.
	14	67	81	29.80	.70	65	SW.	Breeze.	.08	Fog—clear.
	15	67	92	.76	.76	73	W.	do.		Fog: cl'dy: thund. sh'w'r.
	16	68	90	.70	.70	67	W. SW.	do.		Fog—clear.
	17	74	89	.70	.70	64	WNW.W.	do.	.20	Hazy—clear.
	18	72	90	.70	.63	73	W.	Blustering.		Light cl'ds: thund. sh'wr.
	19	68	68	.60	.80	49	W.	Breeze.		Flying clouds.
	20	51	77	30.05	30.10	42	W.	do.		Clear day.
☾	21	58	84	.10	.20	49	W.	do.		Clear day.
	22	60	84	.14	.10	52	W.	do.		Clear day.
	23	59	86	29.94	29.94	51	W.	do.		Light clouds—clear.
	24	63	89	.94	30.00	55	W.	Calm.		Clear day. [realis.
	25	63	88	.94	29.94	58	SW.	do.		Clear day: Aurora Bo-
	26	64	90	.94	.90	62	SW.	Breeze.		Light cl'ds—flying. cl'ds.
	27	71	89	.70	.70	67	S.	do.		Cloudy day.
⊗	28	68	86	.70	.75	63	W.	do.	.04	Light rain—flying clouds.
	29	57	83	30.00	30.10	47	NW.	do.		Clear day.
	30	61	83	.10	.10	55	SW.	do.		Clear day.
	Mean	59.77	79.33	29.82	29.83	58			1.00	

	Thermometer.	Barometer.
Maximum height during the month,	92. on 15th.	30.20 on 21st.
Minimum do. . .	48. on 4th & 6th.	29.50 on 3d and 4th,
Mean do. . .	69.55 . .	29.82

JOURNAL
OF THE
FRANKLIN INSTITUTE
OF THE
State of Pennsylvania,
DEVOTED TO THE
MECHANIC ARTS, MANUFACTURES, GENERAL SCIENCE,
AND THE RECORDING OF
AMERICAN AND OTHER PATENTED INVENTIONS.

SEPTEMBER, 1832.

On the invention and progress of Medal ruling in the United States.

By the Committee on Publications.

(with a copperplate.)

During the time when communication, even between neighbouring nations, was not common, similar inventions were frequently made independently in several different countries and at different times: hence, in the progress of information, perpetual disputes arose as to originality, or priority, and much crimination and bitter feeling were produced.

America *has been* without her journals to put forth the claims of her ingenious men, and the credit of more than one invention has passed from her to those who have been able to give greater publicity to their designs; but this day has passed away, and we find notices of the ingenious works of our countrymen transferred to the pages of foreign journals to be appreciated and acknowledged abroad as well as at home.

We propose briefly to set before our readers a correct history of the invention of a *machine for straight and waved line ruling, and for medal ruling*, which the impressions conveyed by the following paragraphs appear to render necessary.

Extract from the proceedings of the Friday evening meetings of the Royal Institution of Great Britain, as given in the Philosophical Magazine and Annals of Philosophy, for April, 1832.

"*February 3d.*

"Afterwards the beautiful machine constructed by Mr. Bate, of the Poultry, for producing engravings of medals by machinery applied to the surface of the medal itself, or to that of the cast from it, was shown and explained by Mr. Faraday. Drawings would be required to make the description intelligible here. A plate was partly engraved, and many impressions from other plates were shown. Mr. Bate is still engaged in perfecting this instrument."

We are not told who *invented* this machine, but Mr. Bate's claims appear more distinctly in the terms of a patent which he has taken out.

"John Bate, of the Poultry, optician, for an improvement or improvements on machinery applicable to the imitation of medals, sculpture, and other works of art, executed in relief; six months: April 9."—(*Mechanics' Mag.*)

Believing that the credit of the invention of a machine for medal ruling is due to America, we will briefly set forth our proofs, and then speak of the improvements which of late years the method has undergone.

The proofs to be given of the existence and state of a machine are to be derived from the results produced by it.

In 1817, by the use of a machine which had been invented in Philadelphia, Christian Gobrecht, die sinker, produced upon copper an engraving from a medal, having upon it the head of Alexander of Russia: from this engraving impressions were taken and distributed. One of these impressions we have seen.

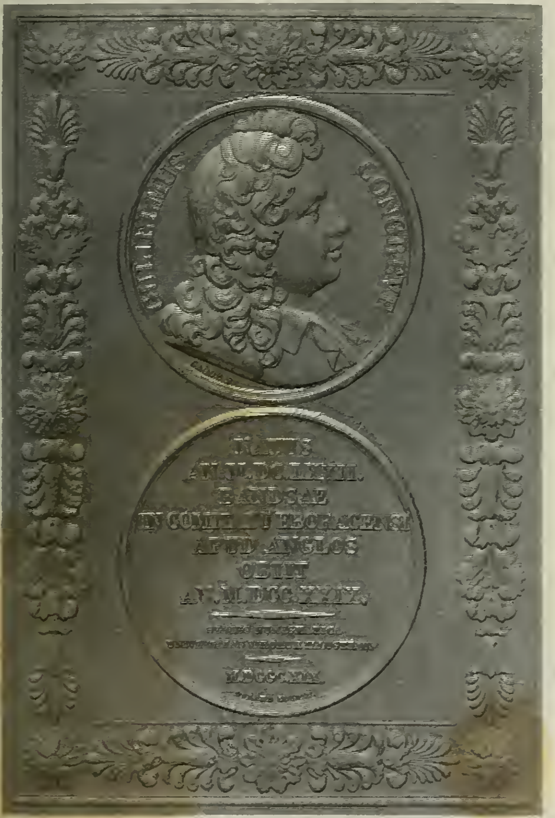
In 1819 Asa Spencer, (now of the firm of Draper, Underwood & Co., bank note engravers,) took with him to London a machine of the kind above alluded to, which was designed principally for straight and waved line ruling. This machine was used in London during the year just mentioned, and the mode of ruling waved lines, and of *copying medals*, was then exhibited and explained by Mr. Spencer to several artists; particularly to Mr. Turrell, who took, by permission, a drawing of the machine, for the purpose of having one made for his own use.

Little, however, was done in the way of medal ruling until about three years since, when a desire to apply the method to the engraving of designs for bank notes caused it to be revived by Mr. Spencer, who bestowed great attention upon it, and overcame the difficulties met with in the outset.

The peculiar construction of this machine has never been made a secret, nor has it ever been patented, although prudential motives have required that it should not be minutely described, and thus be placed in the hands of those by whom its use might be perverted. In consequence of this free communication in relation to this machine, it is now made, with modifications in the details, for engravers, by some of our machinists. We have lately had the pleasure of inspecting one of beautiful workmanship, made by Messrs. Tyler, Fletcher & Co.

The operations performed by this machine are the ruling of parallel straight lines at any required distances apart, and either continuous

Journal of the Franklin Institute [illegible]



MEDAL ENGRAVING EXECUTED BY ASA SPENCER.

PHILADELPHIA.

or broken; ruling converging straight lines; ruling waved lines, the waves being either similar or varying by more or less imperceptible gradations; and medal ruling, or transferring to copper the fac-simile of a medal without injuring its surface, the waved lines presenting a copy of the minutest parts of the medal.

Mr. Bate is said, in the extract which we have given, to be engaged in *perfecting* a machine for medal ruling: in his patent he claims the improvements on a machine for that purpose. It is impossible to say how far this latter claim may be borne out, since a description of the patented improvements has not yet reached us.

That Mr. Spencer has essentially *perfected* this machine as far as beauty of execution, and fidelity of representation in the work to be done by it are concerned, we do not hesitate to say, and that the public here, and our brethren of England, may be enabled to judge for themselves, we have obtained from Mr. Spencer a specimen* of medal ruling executed with his machine, an impression from which we give.

The engraving is made from a copper medal placed in an embossed card of the ordinary kind. The surface of the medal bears not the slightest trace of injury from the machine, and even the yielding surface of the card is not roughened by it.

An impression taken thus from a plate gives but a faint idea of the exquisite effect produced by engravings themselves made by this machine upon a polished surface of gold or silver.

A series of the Napoleon medals, together with a portion of the series of medals struck in commemoration of the events of the first French revolution attest the skill of Mr. Spencer.

If even claims to improvement upon this machine should be established, we trust that what has been here advanced in relation to the invention and progress of medal ruling in this country, will neither be overlooked nor forgotten.

A. D. B.

Description of an apparatus used as a substitute for the Lewis in raising heavy stones. By Wm. Howard, *Civil Engineer.*

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Dear Sir,—I send you the description of a hook or lever for raising stone, which I have found very useful for the particular purpose for which it was intended. It is, I believe, new; but it is very possible that your intimate knowledge of whatever has been done in the way of mechanical contrivances, may convict it of being a "modern antique." If *you* cannot find its prototype, I think I may safely lay claim to it as an original invention: and in that case I would thank you to insert this description in your valuable journal, with a hope that it may be found to be of use in other cases similar to that in which I have employed it.

Yours, respectfully,
Baltimore, July 31*st*, 1832. Wm. Howard.

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* Various specimens of this work have been long since sent to London, and may be found in the possession of Messrs. Perkins and Heath, and of other artists.

DESCRIPTION.

The M'Kim school, now erecting in Baltimore by the liberality and taste of a public spirited individual, is to be an exact copy, as to the portico, of the celebrated temple of Theseus at Athens, and of the precise size of the original. The body of the building is composed of blocks of granite ashler, from Ellicott's mills, each course being of the same height. To permit these blocks to be placed with accuracy and convenience, it was necessary to suspend each one in such manner as to leave its bed and sides entirely free. The Lewis with two pins, represented in fig. 1, and similar to one described in Rondelet, *Art de Batir* was tried, and found to succeed very well, requiring only two holes to be bored about three inches deep, which can be done in the granite with great facility. Still it was desirable to avoid the labour of fitting this Lewis to more than 400 blocks, and the contrivance represented by fig. 2, was invented for the purpose, and has been found to answer perfectly.

It consists of an iron bar, bent in the form A B C D, and of a size proportionate to the blocks of ashler intended to be raised. At C a mortise is made through it, admitting freely the bar H E. This bar is pierced with holes, as shown in the figure, through one of which an iron pin is put, to prevent it from slipping towards H. At F is a plate attached to this bar, between which and the ashler block G, a piece of wood is placed to keep the iron from injuring the worked face of the block. The end D forms a steel pin, which may be inserted about an inch into a hole bored in the block; but in cases where the least projection or shoulder can be found for this point to catch hold of, this labour of boring is not necessary; the smallest prominence being sufficient to give the instrument a perfectly firm hold, or gripe, of the stone, which becomes still firmer as the weight comes to bear on it.

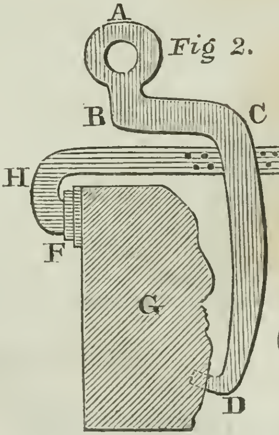
Fig 2.

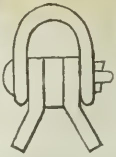
Fig. 1.

Remarks on the Strength of Cylindrical Steam Boilers. By Prof. WALTER R. JOHNSON, *of the Franklin Institute.*

[Read before the Institute at the stated Monthly Meeting, July 26, 1832.]

It has been generally supposed that the rolling of *boiler-plate* iron, gives to the sheets a greater tenacity in the direction of the length, than in that of the breadth. Supposing this to be correct, it has frequently been asked how the sheets ought to be disposed in a cylindrical boiler of the common form, in order to oppose the greatest strength to the greatest strain. It has also been asked whether the same arrangement will be required for all diameters, or whether a magnitude will not be eventually attained, which may require the direction of the sheets to be reversed?

To determine these questions in a general manner recourse must be had to mathematical formulas, assuming such symbols for each of the elements as may apply to any given case of which the separate data are determined either by experiment or by the conditions of the case. The *principles* of the calculation require our first notice.

1. To know the force which tends to burst a cylindrical vessel in the longitudinal direction, or, in other words, to separate the *head* from the curved *sides*, we have only to consider the actual area of the head, and to multiply the number of units of *surface* by the number of units of *force* applied to each superficial unit. This will give the total *divellent* force in that direction.

To counteract this, we have, or may be conceived to have, the tenacity of as many longitudinal bars as there are lineal units in the circumference of the cylinder. The united strength of these bars constitutes the total retaining or *quiescent* force, and at the moment when rupture is about to take place, the *divellent* and the *quiescent* forces must obviously be equal.

2. To ascertain the amount of force which tends to rupture the cylinder along the curved side, or rather along two opposite sides, we may regard the pressure as applied through the whole breadth of the cylinder upon each lineal unit of the diameter. Hence the total amount of force which would tend to divide the cylinder in halves by separating it along two lines, on opposite sides, would be represented by multiplying the diameter by the force exerted on each unit of surface, and this product by the length of the cylinder. But even without regarding the length, we may consider the force requisite to rupture a *single band* in the direction now supposed, and of one lineal unit in breadth; since it obviously makes no difference whether the cylinder be long or short in respect to the ease or difficulty of separating the sides. The *divellent* force in this direction is, therefore, truly represented by the diameter multiplied by the pressure per *unit of surface.* The retaining, or *quiescent* force, in the same direction, is only the strength or tenacity of the two opposite sides of the supposed band. Here also at the moment when a rupture is about to occur, the *divellent* must exactly equal the *quiescent* force.

3. In order to estimate the augmentation of *divellent* force conse-

quent upon an increase of diameter, we have only to consider that as the diameter is increased the product *of the diameter, and the force per unit of surface,* is increased in the same ratio. But unless the thickness of the metal be increased, the *quiescent* force must remain unaltered. The *quiescent* forces, therefore, continue the same—the *divellent* increase with the diameter.

4. Again, as the diameter of the cylinder is increased, the area of its end is increased in the ratio of the *square* of the diameter. The *divellent* force is therefore augmented in this ratio. But the retaining force does not, as in the other direction, remain the same, since the *circumference* of a circle increases in the same ratio as the diameter. The *quiescent* force will consequently be augmented in the simple ratio of the diameter, without any additional thickness of metal. So that on the whole, the total tendency to rupture in this direction will increase only in the *simple* ratio of the diameter.

5. Since we have seen that the tendency to rupture, in both directions, increases in the simple direct ratio of the increase of diameter, it is obvious that any position of the sheets which is right for one diameter, must be right for all. Hence there can never be a condition, in regard to mere magnitude, which will require the sheets to be reversed.

6. The foregoing considerations being once admitted, we may proceed to ascertain what is the true direction of the greatest tenacity in the sheet, if any difference exist, and what that difference might amount to, consistently with equal safety of the boiler in both directions.

7. Let $x =$ the diameter of the cylinder.

$f =$ the force or pressure per unit of surface, (pounds per square inch, for example.)

$\mathrm{T} =$ the tenacity of metal which, with the diameter x and the force f, will be required in the lineal unit of the circumference in order to hold on the head.

Then will the whole *quiescent* force be $3.1416\,x\,\mathrm{T}$, while the *divellent* will be $.7854\,x^2 f$; consequently $.7854\,x^2 f = 3.1416x$ as above stated.

Dividing by $.7854\,x$ we have $xf = 4\mathrm{T}$; and we derive immediately—

$$x = \frac{4\mathrm{T}}{f}$$

$$f = \frac{4\mathrm{T}}{x}$$

$$\text{and} \quad \mathrm{T} = \frac{xf}{4}$$

That is, the tenacity of the *longitudinal bar of the assumed unit in width, will be one-fourth of the product of the diameter into the pressure,* measuring the tenacity by the same standard as the pressure, whether in pounds or kilograms.

8. Now assuming the tenacity required in the *circular band* of the same width to be t, we shall, agreeably to what has already been said,

have the *divellent* force expressed by xf, and the *quiescent* by $2t$, so that $xf = 2t$ and $t = \frac{xf}{2}$. Also $f = \frac{2t}{x}$; and $x = \frac{2t}{f}$.

Having thus obtained two expressions for each of the quantities x and f, we may, by comparing them, readily discover the relative values of T and t,—thus,

$$\left.\begin{array}{l} x = \dfrac{4T}{f} \\ x = \dfrac{2t}{f} \end{array}\right\} \text{hence } \frac{4T}{f} = \frac{2t}{f} \text{ whence } 4T = 2t, \text{ or } t = 2T.$$

From which it follows, that *under a known diameter, and with a given force or pressure, the tenacity of metal in a cylindrical boiler of uniform thickness, ought to be twice as great in the direction of the curve as in that of the length of the cylinder, and that if this could be the case the boiler would still have equal safety in both directions.*

In whatever direction, therefore, the rolling of metal gives the greatest tenacity, in the same direction must the sheet always be bent in forming the convexity of the cylinder. It follows that if we suppose the tenacity precisely equal in both directions, the liability to rupture by a mere internal pressure, *ought to be twice as great along the longitudinal direction as at the juncture of the head.* This supposes the strain regular, and the rivetting not to weaken the sheet.

9. To know how large we may safely make a cylindrical boiler, having the absolute tenacity of the metal, in the *strongest direction*, and with a known thickness, we have only to revert to the formula $x = \frac{2t}{f}$. That is, *the diameter will be found by dividing twice the tenacity by the greatest force per unit of surface, which the boiler is ever to sustain.*

10. When knowing the absolute tenacity of a metal, or other material reckoned in weight, to the bar of a given area in its cross section, we would determine the *thickness* of that metal which ought to be employed in a boiler of given diameter, and to sustain a certain force, we may use the formula $t = \frac{xf}{2}$, and dividing the latter number of this equation by the *strength* of the square bar, which we may call s, we obtain the thickness demanded in the direction of the curve, which we may denominate p; so that $p = \frac{xf}{2s}$; this will give the thickness of the boiler plate either in whole numbers or decimals. Thus, suppose the diameter of a cylindrical boiler is to be thirty-six inches—that it is to be formed of iron which will bear 55000 lbs. to the square inch, and is to sustain 750 lbs. to the square inch,—what ought to be the thickness of the metal?

Here $x = 36$
$f = 750$
$2s = 110000$, consequently,

$p = \frac{36 \times 750}{110000} = .2454$, or a little less than one-quarter of an inch.

It must, however, be evident that the *minimum* tenacity of any particular description of metal, is that on which all the calculations ought to be made when there is any probability that the actual pressure will, in practice, ever reach the limit assigned as the value of f in the calculation.

If we had plates of different metals, or of different known degrees of tenacity in the same kind of metal, and were desirous of ascertaining how strong a kind we must employ under a limited *thickness, diameter* and *pressure,* we should decide the point by transforming the formula $p = \frac{xf}{2s}$, into $ps = \frac{xf}{2}$, and then into $s = \frac{xf}{2p}$. In other terms, in order to know the strength of the metal required, or the direct strain which an inch square bar of the same ought to be capable of sustaining, we must *multiply the diameter of the boiler in inches by the pressure per square inch in pounds, and divide the product by twice the intended thickness in parts of an inch.*

Thus, how strong a metal ought to be employed to sustain a pressure of 1000 lbs. to the square inch, in a boiler thirty inches in diameter, and one-fourth of an inch thick?

Here $s = \frac{30 \times 1000}{2 \times .25} = 60.000$. Hence we see that the metal must be capable of sustaining *sixty thousand pounds* to the inch bar, or in that proportion for any other size. This formula enables us to determine whether among the metals of known tenacity, *any* one can be found to fulfil the conditions under the thickness assigned.

On the basis of the foregoing formulas the following table of diameters, thicknesses of iron, and strains to the inch of metal, in both directions, has been formed.

It is obvious that the *actual* tenacity of the metal employed in a given case must be of the greatest importance to the result. The extensive series of experiments recently undertaken by the Institute to determine this question in reference to different kinds and varieties of boiler plate, and with regard to the various circumstances of its manufacture and application, will hereafter furnish us with important data to aid in applying the formulas to each separate case. I shall for the present assume the tenacity of an inch square bar of rolled iron at 55,000 pounds, in the direction of the length of the sheet. Supposing the pressure generally employed in cylindrical high pressure boilers to be 150 lbs. to the square inch, agreeably to the practice in this city, the table is calculated upon the principle that the boiler ought to have five times as great a strength as it is ordinarily required to exert. The calculation is upon a continuous sheet of metal without seams in any direction. The thicknesses are given in ten-thousandths of an inch; but in practice the last figure may be omitted without material error.

Diameter of the boiler in inches.	Thickness of plate iron which will bear 55,000 lbs. to the square inch required to resist the strain in the direction of the curve under a pressure of 750 lbs. to the square inch—calculated by the formula $p = \frac{xf}{2s}$.	Corresponding tenacity of each inch wide ring or band, required to support a pressure of 750 lbs. to the square inch, calculated on the formula $t = \frac{xf}{2}$.	Tenacity required in each longitudinal bar of one inch wide to sustain the pressure tending to burst out the head; calculated on the formula $T = \frac{xf}{4}$.
Inches.	Inches.	Pounds.	Pounds.
1	.0068	375	187.5
2	.0136	750	375
3	.0204	1125	562.5
4	.0272	1500	750
5	.0341	1875	937.5
6	.0409	2250	1125
7	.0476	2625	1312.5
8	.0545	3000	1500
9	.0613	3375	1687.5
10	.0681	3750	1875
11	.0745	4125	2062.5
12	.0818	4500	2250
14	.0954	5250	2625
16	.1090	6000	3000
18	.1227	6750	3375
20	.1363	7500	3750
22	.1490	8250	4125
24	.1636	9000	4500
26	.1773	9750	4875
28	.1909	10500	5250
30	.2045	11250	5625
32	.2182	12000	6000
34	.2318	12750	6375
36	.2455	13500	6750
38	.2591	14250	7125
40	.2727	15000	7500
42	.2860	15750	7875
44	.2980	16500	8250
46	.3116	17250	8625
48	.3252	18000	9000
50	.3388	18750	9375

13. I am not aware that this subject has been previously treated in a general manner, at least as it regards several of the points above presented. Mr. Oliver Evans made some particular calculations of the strength requisite to sustain the pressure in a boiler of known dimensions, under a tension of 1500 lbs. to the square inch. In the table at page 27th of his "Young Steam Engineer's Guide," he has given calculations for seventeen different diameters of boilers, with the

power which, at each diameter, the steam would exert "to break every ring of one inch wide in any place," and "the thickness of the sheets of good iron necessary to hold the power." His table is formed on the supposition that sheet iron will bear 64,000 lbs. to the square inch, and would consequently lead to considerable *excesses* if strictly applied in practice. To six of the diameters he has annexed the "power exerted on the heads to burst them out in pounds weight." These he has calculated in the usual manner, by multiplying the area by the pressure per inch. Opposite to three of the numbers just mentioned, he has added "the strength of the boiler to hold the head on in pounds weight."

These he has calculated on the supposition that the metal had equal tenacity in all directions. On this supposition, and on the principles above developed, each of these three numbers should have been exactly double of that against which it stands in the preceding column. Neither of the three is so, precisely; but the first and third come as near it as could be expected, considering that the thickness is expressed only in 100ths of an inch; while the second is too small by more than a million of pounds.

These errors would not, I apprehend, have occurred, had the author adverted to the general principle above developed in regard to strength required of the metal in the two directions.

The following extract from the table just alluded to, will illustrate the preceding remarks. A column of corrected results has been added.

(See "Young Steam Engineer's Guide," p. 27.)

Diameter of the boiler in inches.	Power to break each ring of one inch; pressure being 1,500 lbs.	Thickness of the plate of iron of 64,000 lbs. to the sq. in.	Power exerted on the heads.	Strength to hold on the heads.	Corrected numbers to be substituted for those of column 5, agreeably to the foregoing remarks.
42	31.000	.48	2.077.500	4.052.400	4.155.000
36	27.000	.42	1.525.500	2.037.440	3.051.000
20	15.000	.23	471.000	918.777	942.000

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MARCH, 1832.

With Remarks and Exemplifications, by the Editor.

1. For an *Apparatus for ventilating Vessels, and purifying and cooling the air of Steam-boats;* Jesse Remington, city of Baltimore, March 1.

To be ignorant of the nature and preparation of such an agent as chlorine, is no disgrace to a person whose pursuits have not been scientific; but for one so situated to pretend to have discovered new modes of applying it, manifests a degree of temerity which might well excite surprise were not events of a similar character so common; and that they are common is strikingly exemplified by our monthly analysis of the transactions of the patent office. The instance before us is an example of that utter failure which may well be anticipated when ignorance and temerity, such as we have spoken of, unite in an attempt at scientific investigations, and in a claim to scientific discovery.

It is proposed to make a metallic reservoir of one foot in diameter, and eighteen inches in height, with a screw cap to close it up; and this reservoir is to contain a solution of chloride of lime, or of chloride of soda. A force pump, the cylinder of which is to be a foot in length, and its diameter five inches, surmounts the reservoir, and by it atmospheric air is to be forced through a tube which dips into the solution: from the upper part of the reservoir, above the solution, copper tubes are to lead into the hold of the vessel. This constitutes the whole apparatus, and exhibits all the agents to be employed, unless we count the man who is to work the pump handle. But in what way are these to operate? The patentee says that the atmospheric air being forced by the pump through the chloride, is impregnated with it, and consequently he claims as his invention "impregnating air with chloride in the reservoir as before described; also in giving an agreeable odour to the air when purified by the same apparatus; or conveying pure atmospheric air by the same apparatus."

When air is thus forced into the hold of a ship, or other vessel, it is manifest that were the vessel perfectly air tight, and the operation persevered in *long enough*, she must explode; to avoid such a catastrophe, and to allow of the exit of the foul air, "openings are left in the deck around the mast, or in any convenient situation, for its escape."

When the patentee has informed us in what way the air becomes impregnated with *chloride*, he may next undertake to instruct us in the method of surmounting insurmountable difficulties, or of arriving at the bottom of the bottomless pit. The fact is that by the proposed process, the air of the atmosphere would acquire a slight odour of *chlorine;* and that, principally, in consequence of the action of the minute portion of carbonic acid contained in it, but its influence would be as that of a drop in the ocean. If the patentee had directed the throwing of the dry chloride, or the pouring of its solution into the hold of the vessel, such direction would have been good, but then his patented apparatus would not have come into play.

The idea of purifying a ship's hold by forcing into it a gallon of atmospheric air at every stroke of a piston is too absurd to be entertained for a moment, yet even this is more rational than the proposed impregnation with *chloride.*

We have been induced to extend our notice of this *invention* to an unmerited length, and our reason for doing this is a knowledge of the fact that application has been made to the Navy Board to adopt this apparatus in the national marine. All we can say in its favour is that it is as harmless as it is useless.

2. For a *Thrashing Machine;* Nathaniel Adams, Westmoreland, Oneida county, New York, March 2.

The beaters on the cylinder are to be of cast iron, and we are told what is about the proper length for the teeth, and the distance between them, and how they are to be fastened on to the cylinder. The concave is likewise to be cast, and with teeth on it formed by grooves, it is to be suspended on springs regulated by screws, &c. The claim is to these *peculiarities*, if such they are; but the host of thrashing machines is too great to admit of their being mustered and inspected to see whether their accoutrements may not differ in some minute point from that before us. Besides this, after we had taken all the trouble we could, we might fail to accord in opinion with the patentee, a sin we have committed in our last lucubration, and one which we will not repeat until we are compelled to do so.

3. For *Boring or cutting out the ends of the Hubs of wheel carriages to receive the Boxes;* John B. Francis, Louden county, Virginia, March 2.

The hub to be bored is fixed within a sort of cage work composed of different pieces of iron adapted to the purpose of holding it centrically, and steadily, on a wooden frame. It is sustained upon this frame by making it the bearings for a cylindrical iron spindle which passes through the hub, and upon which it is capable of being turned round. For this purpose the spindle slides through holes in iron plates forming a part of what we have called the cage work, and into these holes the spindle fits accurately. By means of a mortise in the spindle, suitable cutters are fixed by wedging, or otherwise, which cutters are adapted in size and structure to the hole to be cut. When the respective parts are fixed in their proper places, the spindle is secured from turning round; the hub, or wheel, is then turned against the cutter, and the hole sunk to the proper depth.

4. For a machine for *Hulling Clover Seed;* Christopher Seabold, jr. New Berlin, Union county, Pennsylvania, March 6.

A shaft about five feet long, is turned, for three and a half feet of its length, to a diameter of six inches, and then increasing in diameter, along the remaining eighteen inches, to about eight inches. This shaft is made to revolve upon gudgeons in a suitable frame, but inclined from the horizon, the thicker end being the lowest. A spiral row of wooden pins is placed round the cylindrical part of the shaft, making three or four turns in its length. On the conical part of the shaft there are small steel pins, also driven spirally, but near together. A circular casing surrounds this shaft its whole length; that part of it in which the steel pins run is of sheet iron, punched to form a grater. The hopper is placed at the upper end of the casing, and as the shaft revolves the clover is carried within the casing by the wooden pins, until it arrives towards the other end, where it is operated upon by the apparatus described.

The claim is to the before described machine; and particularly to the spirally set pins for conveying the heads to the rubber, and the spirally set metal pins for rubbing it out.

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5. For a *Planing machine,* called the Horizontal Knife and Roller Plane; Uri Emmons, city of New York, March 6.

This machine, we are apprehensive, will not answer the purpose intended, unless the boards to be planed are first rived from trees perfectly straight in the grain; and even then we do not think that it would answer well. We shall be ready to retract the opinion thus expressed when a workman can be found who with a drawing knife can take a single shaving from end to end of a flooring board, and in this way leave it with a smooth finish.

The stuff to be planed is to pass between two iron rollers, either plain or fluted, the upper roller having on its ends iron fly wheels, which press it down on the board, and insure its feeding against the knife by which the planing is to be effected. The knife, or plane iron, is fixed exactly against the front of the upper feeding roller, extending along and cutting the whole width of the board at one operation. Cutting irons for tonguing and grooving are at the same time to act on its edges, and are at once to cut the tongue and the groove.

We do not think it necessary to describe the various accessory parts mentioned by the patentee, and figured in the drawing, as we have little doubt that those persons who have any knowledge upon the subject, will, from what we have already advanced, have arrived at the conclusion with which we commenced our remarks.

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6. For a *Machine for Moulding Bricks;* called "Drummond's Brick Moulder;" John Drummond, Whitestown, Oneida county, New York, March 6.

Without the aid of the engraver we cannot give an exact description of this machine, nor indeed are we aware that any thing further than a general idea of it is requisite. The prepared clay is put into a hopper, and the brick moulds placed upon a carriage, are forced, by means of a rack and pinion, under this hopper. As the brick moulds pass under, a row of rollers, seven in number, crossing the hopper near its bottom, and made to revolve by a band, forces the clay into the moulds. A wire, made to vibrate horizontally on the upper surface of the moulds as they escape from the rollers, cuts off the superfluous clay, which is removed by a kind of scraper.

The use of the rollers, and the vibrating wire for cutting the superfluous clay from the mould, are the points relied on as new.

7. For a *Medicine for the cure of Syphilis;* called "The Unfortunate's Friend;" Nicholas W. Bardean, city of New York, March 8.

In the first place a decoction is to be made by taking two pounds of liquorice root; of sarsaparilla root, guiacum, elder flowers, and raisins, each one pound; of mazereon root, burdock root, parsley root, and dried whortleberry leaves, each half a pound; putting them into four gallons of water, and reducing it to two by boiling. Into the warm, strained decoction, there is to be put of balsam copaiva and sweet spirits of nitre, each two pounds; of gum arabic, white sugar, cubebs and carbonate of soda, each one pound, and of gum opium one ounce.

This is the recipe, but it is given to us without any directions as to its exhibition. Should those who are so unfortunate as to be affected by the vile disease in question, depend for a cure upon the foregoing Friend, "Alas, poor Yorick!"

8. For *Machinery for preparing Hides for Tanning;* Lewis Newsom, Gallipolis, Gallia county, Ohio, March 8.

There is to be a circular trough of about fifty feet in circumference, which is to be made of timber, and may be nine inches wide, and eight deep. A wheel of stone, or of wood, about four feet in diameter, is adapted to this trough by allowing it to revolve on the end of a horizontal lever, attached to a vertical shaft in the centre of the trough. Mills of this description are well known; and, as the patent is for the machinery employed, this ought to have some novelty.

Hides intended for tanning are to be softened in the trough, and those which have been limed are to have the lime worked out in it, preparatory to their going into the first bark liquor. When hides are to be put into the vats they are to be fastened to frames made for the purpose, on which they can be hooked; these frames are lowered into, or raised from the vats, by means of suitable tackle.

Hides have been suspended and lowered in similar ways, and the modes of effecting it have been made the subjects of patents.

9. For an improvement in *Harness Saddle Trees;* Philo Washburn, Bristol county, Massachusetts, March 8.

This saddle tree is to be made entirely of wrought iron. In the middle, where it is fitted to the ridge of the horse's back it is to be made quite narrow, whilst the sides are widened and flattened out. The terrets and water hook screw into holes prepared for them, and the tree, when properly padded, is complete. The claim is to the wrought iron tree, as a substitute for wood, it being more compact and stronger than that material.

10. For a *Machine for cutting Sausage Meat;* John Brannan, city of Baltimore, March 8.

The whole description of this machine, including the claim, extends to nine lines only, but as these refer to a drawing, we shall be obliged to be somewhat more prolix. The sausage meat is put into a round tub, or trough, which is to revolve on an axis. A horizontal axis above the tub carries a double crank and pitmen, which work knives up and down within the tub. These knives are kept in motion by turning a winch, or handle, on the shaft of which there is a cog wheel taking into a pinion on the crank shaft; and a vertical shaft, turned by an endless screw, on the horizontal one, has a pinion on its lower end, which, mashing into cogs surrounding the tub, causes it to revolve. The claim is to this last part of the apparatus. There is some slight difference in the mode in which this tub is made to revolve, and that of others which have received a similar motion, but in the principle of the machine there is nothing new, and its variation from others can scarcely be called an improvement.

11. For *Rail-ways and Cars used thereon;* Jedediah Richards, Elbridge, Onondaga county, New York, March 9.

The rail-way is to be a single rail, sustained by suitable supports. Two wheels, in a frame made for the purpose, are to run on this rail, the car being suspended under it by iron rods attached to the frame of the wheels.

The claim is "to the before described improvements in rail-ways, and in the cars or carriages used thereon."

Single suspension rails were patented in England by Mr. H. R. Palmer, six or seven years ago, and are described in this journal for April, 1828; they, however, have never been brought into practical use. There is but little difference between the present plan and that proposed by Mr. Palmer; the principle of both is the same, and we do not think that Mr. Richards has made any improvement on that first suggested, nor has he alluded to it, but has taken his patent as though single rails were absolutely new.

12. For a *Mill for Grinding Apples and Potatoes,* and for shelling corn; Edmund Harris, James Newton, Willard Webster, and Jehiel W. Dart, Truxton, Courtland county, New York, March 10.

A spindle, running vertically, carries the runner of this mill, which is a stone made hemispherical, or more or less curved above, but flat beneath. The cap stone is hollowed, like a bowl, to adapt it to the curvature of the lower stone, and has an eye in it for the spindle to pass through, and also for feeding.

"The invention claimed is the grinding apples, potatoes, and shelling corn, as above described, with stone, and in the cheapness and durability of the mill."

Whatever may be the merits of this mill, its claim to novelty is a very slender one; the contribution of each of the four inventors must in fact be so minute as to be almost invisible, although it seems that there was "quite enough to swear by."

13. For a machine for *Making Crackers, Ship Bread, &c.;* John Bruce and Charles Bruce, Brooklyn, King's county, New York, March 13.

A long sliding table, or platform, is to be fixed upon a suitable stand, or frame, with ledges to guide it, and cause it to slide forward and backward in a direct line. Upon this table the dough to be formed into crackers, ship bread, &c. is to be rolled out. There are three rollers, or cylinders, the gudgeons of which run in cheeks rising from the frame on each side of the platform, and having their axes nearly in the same horizontal plane, but not precisely so, the roller with which the dough first comes into contact being farther from the platform than the second, and the third, or last, being still nearer than the second, its distance being such as to reduce the dough to the thickness required. The first roller is turned by a crank, and on its ends are toothed wheels which take into the teeth of racks on each edge of the platform, thus forcing it to advance.

There is a fourth cylinder, called the cutting cylinder, which crosses the platform immediately in front of the last roller. This cylinder is surrounded with circular, or other formed, cutters, the edges of which extend down to the platform. Within each of the cutting moulds there may be docking points, a die with a name, &c. A plate, nearly filling the inside of the mould, and perforated, when necessary, to accommodate the dockers, is borne forward by spiral, or other springs, to force the cut cracker, &c. out of the mould.

The claims are to "the use of two or more cylindrical rollers successively, to reduce the dough to its desired thickness, in connexion with the aforesaid cutting cylinder; the use of the aforesaid cutting cylinders containing cutters of the ordinary description, whether it be so constructed as to make circular biscuits, or the same, or similar articles, of any other shape or form whatever."

We refer those who are interested in the subject of machines for manufacturing crackers, to the several patents for apparatus for that purpose, which we have formerly noticed. On comparing the description and claims above specified with those of Clark & Henderson, vol. vi. p. 302, and Fairbanks & Dunott, vol. viii. p. 343, we think it will appear that a considerable portion of the ground claimed by the present patentees, is such as has been previously occupied.

14. For an improvement in the *Manner of supplying Steam Boilers;* Jesse Fox, Lowell, Middlesex county, Massachusetts, March 14.

Those who are well acquainted with the different modes which have been adopted for supplying boilers with water, know that it is sometimes done by causing a cylinder, or a conical plug, to revolve in a suitable case, like the key of a cock in its socket, and having at one point, a cavity within it, which as it turns, is filled with water from a reservoir above it, and in its revolution delivers it therefrom into the boiler. The plan before us is of this character, but in the structure and arrangement of its parts appears to be new, and well conceived; without the aid of a plate, however, we can attempt no more than a very general description of it.

The revolving piece which has the cavities in it for the reception and supply of water, is a cylinder of iron four inches and a half in diameter, and one and a half in thickness; this cylinder revolves on a suitable axis, being enclosed for more than half its circumference in a casing, which is furnished with a flanch, by which the apparatus is attached to a boiler. A hole is made in the boiler to admit a projecting part of the revolving supply wheel, which is nearly equal to one-half of it. This wheel is perforated on opposite sides, so as to remove nearly one half of its substance. Imagine it to be divided into four parts, or quadrants, the part removed consists of two opposite quadrants, leaving a rim, however, of one-fourth of an inch in thickness at the outside, and an equal portion round the gudgeon at the centre. These cavities, as the wheel revolves, are alternately exposed to the pressure of water in a reservoir from which they are filled, and to the inside of the boiler, into which the water falls from them, both sides of the wheel being equally acted upon by the steam.

The perforation of the boiler is at the point intended for the water line, in order that the tendency of the wheel may be to carry back as much as it supplies when the boiler is sufficiently full. The claim is to the apparatus as described.

A principal objection to revolving wheels of this description is their gradual wear, which, although they may operate satisfactorily at first, soon unfits them for the duty they are to perform. Should this objection be removed, the principle is undoubtedly a good one.

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15. For a *Washing Machine;* Noah Morrison and John Lewis, Union Town, Fayette county, Pennsylvania, March 14.

This is called the "horizontal, double dasher, washing and scouring machine.

A trough has a shaft crossing it near its centre, and carrying two cranks; pitmen from these cranks cause two sliding dashers to traverse in the trough in opposite directions, and to squeeze between them and a breasting prepared for the purpose, the clothes put in at either end of the machine.

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16. For a *Mill for grinding Paints;* Oliver C. Harris, Sangerfield, Oneida county, New York, March 15.

On the upper part of a suitable frame a circular hopper, or curb, is placed; it is made of cast iron, and is to receive the paint to be ground. The lower part of this hopper is made conical to receive from below the runner, or nut, formed like that of the common coffee mill, this is also of cast iron, and has a shaft, or spindle, by which it is to be turned, extending down to a bridge tree. There is an elastic scraper bearing against the under rim of the runner to scrape off the paint. The edges of the runner and of the hollow cone are to have teeth on them; and the shaft, or spindle, is to be turned by a crank carrying a toothed wheel, taking into a pinion on the shaft.

There is no claim made, which we think is just as it should be, obviating a great difficulty by saying nothing about novelty.

17. For a *Faucet for drawing Liquids;* called Goodyear's spring and lever faucet; Charles Goodyear, city of Philadelphia, March 16.

These faucets, or cocks, have nearly the same external form with the block-tin cocks in common use; but instead of the screw plug in them, or the revolving key of the common cock, they are opened by raising a valve perpendicularly, which is kept down in its place by means of a spiral spring. The exterior end of the cock is a hollow vertical cylinder, the top of which is closed by a cap, whilst the lower end is left open. A rim or shoulder surrounds this lower end, rendering the opening smaller than the cylindrical barrel above it, and upon this shoulder the valve rests. The valve is a circular disk of metal, on to the lower side of which there is a tube that forms the spout, or adjutage of the cock; this tube fits exactly into the rim upon which the valve rests, and when the valve is raised a part of this tube slides up into the cylindrical chamber. A perforation is made in the side of the tube, which, when it is thus raised, allows the liquor from the shank of the cock to flow through it. A spiral spring, extending from the cap of the chamber, on to the top of the valve, keeps it in its seat. The valve is raised by two wires which descend from the top of the chamber, at the outside, and opposite to each other, and are fastened below into ears projecting from the tube. These wires are connected at the top, and when raised are acted upon by a small lever; and to keep them in their proper places and cause them to rise vertically, they slide through holes in projecting rims made for that purpose.

The claim is to the application of a spiral spring to a valve in the manner described.

A cock so constructed will undoubtedly operate very well, but the spiral spring being constantly surrounded by the liquor, will, we apprehend, be liable to corrosion by some liquids, or to be furred up by others.

18. For a *Silk Reel,* for reeling silk from cocoons; Eliphalet Snow, Mansfield, Tolland county, Connecticut, March 6.

The silk reel is a very simple instrument, and although it has been made in various forms, its essential parts are the same. The present patentee has described his own form of reel, but without telling what particular advantages it possesses over others, or claiming any part as new. As we are unable to supply these deficiencies, we shall not attempt to follow him in his description.

19. For a *Revolving Lath Cutter;* Simon Willard, Cincinnati, Hamilton county, Ohio, March 16.

A cylinder, which, for laths of the ordinary length, may be about five feet in diameter, and of the length of the lath, is made to revolve on a strong iron shaft. The ends of the cylinder are best made of cast iron, as the whole machine must have great strength and weight. The periphery of the cylinder is of wood, and turned perfectly true; one or more cutters, formed of strong flat iron bars, faced with steel, extend from end to end of the cylinder, the distance from which to the cutting edge forms the gauge for the thickness of the lath. A horizontal bar of wood, having on it one of iron, serves as a rest upon which the timber to be cut is held. The edge of the board, held upon the rest, is forced up against the face of the cylinder, whilst the latter is revolving. The width of the lath is determined by the thickness of the board used.

There are several accessory parts, such as a revolving apron, or other contrivances, for carrying off, and collecting together, the laths, but these we do not think it necessary to describe.

The claim is to the combination of revolving cutters, a cylinder, and other machinery, as described, for the purpose of cutting laths.

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20. For a *Smoke Ventilator;* Silas Smith, Hamilton, Butler county, Ohio, March 17.

This smoke ventilator is a modification of the well known valve, or damper, employed to open or close the throat of a chimney. Its distinguishing feature consists in making the sloping back of the fire place of cast iron, and fixing it so that it will work upon hinges, or pivots, at bottom. This is to be altered in its slope by means of endless screws fixed near its upper part. When brought forward, it closes the throat in any desired degree. The upper part of this moveable plate curves back, to favour the exit of the smoke, and to form a mechanical obstruction to a downward draft.

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21. For *Machinery for Printing;* John Hatch, Boston, Massachusetts, March 21.

This is a new contribution to the list of power presses, the introduction of which has done so much in facilitating the typographic art. In a complex machine of this description, the parts are too numerous, and the peculiar combination which constitutes the essential characteristics of a new or improved machine, too dependent upon minute points to admit of their being given without drawings. To such particulars the claims made by the present patentee refer, and we therefore dismiss the subject, at present, without an attempt at description.

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22. For a *Thrashing Machine;* Abel Lock and William Coleman, jr., Frederick city, Frederick county, Maryland, March 21.

This machine is described with much brevity, and makes no pretention to novelty. We are told that there is in the first place a suitable frame; in the second, a hopper or revolving apron for feeding; in the third, a hollow revolving cylinder, the perimater being made of plates of iron, passing spirally from head to head, and carrying projections, or teeth; and fourthly, a concave bed with similar teeth. Having said thus much, the patentees sign their names, and take their leave.

23. For a *Clothes Line Vice;* Samuel Pryor, Salem, Salem county, New Jersey, March 22.

A strip of hickory, about six inches long, is to be bent in the middle, so as to bring the two ends parallel to each other, forming a clamp about two and a half inches long. A wooden screw is made to draw these together, and the machine is then prepared to hold clothes upon lines whilst drying.

We do not think that this patented instrument is, upon the whole, superior to the common clamp, as it will, when caught in a shower, or otherwise exposed to wet, be found to swell, and this will interfere with the working of the screw.

24. For a *Shingle Cutting Machine*; George Wolf, Clear Creek, Fairfield county, Ohio, March 22.

It appears, so far as we can collect from an obscure description, and a still worse drawing, that knives are to be set in a stock, which stock is to be made to traverse against the block by a crank motion. Such machines are quite common, and have but little merit, performing the work very imperfectly.

25. For an improvement in the *Saw Mill;* Vachel Blaylock, Bellefontaine, Logan county, Ohio, March 24.

N. B. The word improvement, when applied to patents, is not by any means to be taken in its ordinary acceptation, as in numerous instances it means any thing rather than the rendering of a machine better than it was previously. In a patent dictionary the definition which would most generally apply would be *alteration*, as this would include both the mending and the marring of any such article as may be altered.

This improved saw mill is to be moved by the power of a horse, kept walking in a circle, and thereby turning a vertical shaft in the common and long approved way. A wheel on the lower end of the vertical shaft, gears into one on a horizontal shaft, which is to be so covered as to allow the horse to walk over it. This horizontal shaft carries a vertical spur wheel eight feet in diameter, which turns two pinions, the shafts of which run on bearings in suitable supports. According to one part of the specification there are to be cranks on the far ends of these pinion shafts, each carrying a saw frame; but according to another part there are to be cams upon each of the pinion shafts, operating on the opposite ends of a lever having a fulcrum in its centre, and made to vibrate like a scale beam by the action of these cams on its lower side; the drawing seems to confirm this latter structure as the approved one. The ends of this lever are employed as substitutes for cranks in operating upon saw frames. The whole gearing as described, with the addition of the friction of the cams, acting in the way shown in the drawing, will add a liberal percentage to the necessary friction, and prevent all danger of the horses employed suffering from dyspepsia if labour will prevent that disease.

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26. For a *Bark Mill;* Daniel Humberd and George Downs, M'Connelstown, Bedford county, Pennsylvania, March 27.

The claim made by these patentees is to "the before described machine or mill for grinding bark," adding "we make no claim to the runner and bed." What they call the runner and bed, is the common cast iron bark mill. The shaft of this is to be turned by animal power in the common way, a horizontal cog wheel giving motion to a trundle head on the shaft of the mill. A circular trough, or curb, is to catch the bark as it falls, and prevent it from scattering.

It is quite plain from the foregoing that the patentees imagine that it is the patent, and not the originality of the thing patented, which gives the right, as there is not the slightest pretension made by them to the invention of any thing, nor the slightest room to urge such a pretension.

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27. For an improvement in the construction of *Backs for Forges* and other fires; Philo C. Curtis, Utica, Oneida county, New York, March 27.

This forge back is a box made of cast iron, about twelve inches long and ten high, and it has a depth from the fire back of about six inches. The object proposed is to supply this box with wind in such a way as to blow heated air into the fire, whilst that side of it which is in contact with the fire shall be preserved from burning out.

The box is cast in two parts, capable of being put together so as to be air tight. The wind from the bellows passes in at one end of it, and escapes into the fire through a hole in the front plate, which forms the forge back. There is a centre plate, twelve inches long and ten high, which is put into the box, dividing it into two chambers; this centre plate is perforated with numerous small holes, and has one of a larger size corresponding with the hole in the front plate; the tube, or tuyere, which conducts the wind to the fire, fits into both these holes, so that all the wind must come from the posterior chamber, whilst the wind from the bellows passes into the anterior chamber.

The operation will now be readily understood. The wind which passes into the anterior chamber, having to pass through the small holes in the centre plate, before it can arrive at the tuyere, and coming into contact with the heated plate which forms the forge back, becomes itself heated, and in becoming so cools the front plate.

The patentee says that a considerable portion of coal is saved by thus using heated air. On this subject we refer our readers to p. 339

of the last volume, where the advantage of supplying a furnace with heated air is particularly noticed.

The claim in the present case is to applying wind from the bellows against the back of a plate exposed to the fire, and also to the particular mode of so doing, as explained in the specification.

28. For an improvement in the *Mode of Spinning Wool,* for the manufacture of coarse or heavy fabrics, and particularly for ingrain carpeting; William Calvert, Royal Southwick, and Alfred Messinger, Lowell, Middlesex county, Massachusetts. The former an alien, having resided here two years; the two latter citizens of the United States. March 31.

The machine here patented is well represented in the drawing, and explained with sufficient clearness in the specification; still the parts which are new are not designated, but left to be inferred by those acquainted with such machinery. This does not fulfil the requirements of the law, yet we presume that by a liberal construction of it, the rights of the patentees might be sustained.

The patentees state that this machine resembles those in general use for spinning worsted and cotton; but that from placing the rollers nearer together than in worsted machinery, and making them larger than in that for cotton, it produces yarn which could not be obtained from either of them.

The wool is taken from the carding condenser on to a feeding cylinder, whence it passes through all the rollers, of which there are three pair; two being small, and placed between the ordinary drawing rollers. The feeding cylinder, it is said, has never before been applied to the throstle frame.

The difference in the mode of spinning from that in other machines is that it is effected by a continuous motion; the thread being wound on the bobbins, or spools, as fast as the roping is discharged from the rollers, the rollers not stopping, as in the common machines, whilst the roping is drawn and twisted.

It is averred that three times the ordinary quantity may be spun by one of these machines; six spindles producing as much as eighteen have heretofore done.

The quality of the yarn is said to be much improved, the fibres being drawn nearly straight, as in worsted. Several other advantages are enumerated by the inventors, who have taken much more pains to inform us what the machine does, than how it accomplishes its work. Patentees are often anxious to make known in their specifications the utility of their inventions, a point which may be omitted altogether without any disadvantage, the main question being that of novelty.

ANALYSIS OF THE REPORT, &c. ON STEAM CARRIAGES.

Report on Steam Carriages by a Committee of the House of Commons of Great Britain. With the minutes of Evidence, and Appendix. Reprinted by order of the House of Representatives of the United States. (1832.)*

We are indebted to this reprint of the report on steam carriages, by a committee of the House of Commons of England, for the means of placing before our readers the results of a most interesting investigation into the progress made in the attempts at locomotion, by steam carriages, upon common turnpike roads.

In this country was made the first successful attempt to move a carriage, upon a common road, by steam power applied to give rotation to the wheels. In the year 1804 the dredging machine of Oliver Evans was propelled by the adhesion of its wheels from Broad street to the Schuylkill, and the engine of the machine was further used to propel, by a paddle wheel, the scow in which it was placed, down the Schuylkill, and up the Delaware, to the station where it was to be used.

It may be yet some time before the ingenuity of our countrymen is turned to the application of steam power which we are about to consider: our roads must be more or less improved both in relation to their longitudinal and to their transverse section. To induce this expense, an amount of travelling must be secured, between our inland towns, not likely to take place for some time. The magnificent water courses which facilitate our communication between the large cities on the Atlantic board, and between the growing towns of the west, have led to the acknowledged superiority which we enjoy over our transatlantic brethren (the English,) in the application of steam to navigation: our extent of territory, and the sparseness of its population have been strong inducements to a devoted attention to this subject. The peculiar facilities of rail-road communication between vast commercial and manufacturing depots, has caused England to precede us very far in that mode of communication, and, consequently, in the application of steam power to locomotion upon rail-ways. Until steam coaches shall have been made to travel upon common roads at a more rapid rate than our combined water and land communications can enable us to attain, thereby to shorten the time of passage between some of our large cities, we can hardly expect that this species of locomotion will receive much of the attention of the public. By keeping up with the state of information in England upon this subject, we shall always be prepared to take advantage of a proper opening for the introduction of such a mode of communication, with the advantage of the experience which might otherwise have been dearly bought. No doubt there are portions of our better roads which might be made available, for a short distance, for profitable speculation in this new sort of locomotion.

Much of the evidence before the committee of the House of Commons is of local interest merely, and many of the statements would find no application with us: a part even of the report of the committee might, perhaps, have been omitted, or have been condensed, without injury to the interests of our readers; we have, however, preferred to insert it unmutilated.

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* COM. PUB.

The inquiry with which this committee was charged grew out of representations made by those interested in the new application of steam to locomotion, in relation to the heavy tolls imposed upon their carriages on the different turnpikes. The subject, as referred to the committee, took, however, a wider range than that of a mere inquiry in relation to the tolls. The objects of examination were, first, in relation to the tolls which ought to be imposed upon coaches and other vehicles propelled by steam or gas upon turnpike roads, together with the tolls at present imposed; second, in relation to the present state and future prospects of this application to locomotion upon common roads, with the probable utility resulting to the public from such an application.

We purpose first to give the report of the committee, and afterwards, by extracts from the minutes of evidence, and condensed views of the more interesting parts of it, to put our readers in possession of the material facts developed in the examination.

Report of the Committee on Steam Carriages. Charles D. O. Jephson, *Chairman.*

"The committee proceeded, in the first instance, to inquire how far the science of propelling carriages on common roads by means of steam or mechanical power, had been carried into practical operation; and whether the result of the experiments already made had been sufficiently favourable to justify their recommending to the House that protection should be extended to this mode of conveyance, should the tolls imposed on steam carriages, by local acts of parliament, be found prohibitory or excessive.

"In the progress of their inquiry, they have extended their examination to the following points, on which the chief objections to this application of steam have been founded, viz.—the insecurity of carriages so propelled, from the chance of explosion of the boiler, and the annoyance caused to travellers, on public roads, by the peculiar noise of the machinery, and by the escape of smoke and waste steam, which were supposed to be inseparable accompaniments.

"It being also in charge to the committee, 'to report upon the proportion of tolls which should be imposed upon steam carriages,' they have examined several proprietors of those already in use, as to the effect produced on the surface of roads by the action of the propelling wheels.

"As this was too important a branch of their inquiry to rest entirely on the evidence of individuals, whose personal interest might have biassed their opinions, the committee also examined several very scientific engineers, by whose observations, on the causes of the ordinary wear of roads, they have been greatly assisted.

"The committee were directed also to report 'on the probable utility which the public may derive from the use of steam carriages.' On this point they have examined a member of the committee, well known for his intelligence and research on subjects connected with the interests of society, and they feel that they cannot fulfil this part of their instructions better than by merely referring the house to the evidence of Colonel Torrens.

"These inquiries have led the committee to believe that the substitution of inanimate for animal power, in draught on common roads, is one of the most important improvements in the means of internal communication ever introduced. Its practicability they consider to have been fully established; its general adoption will take place more or less rapidly, in proportion as the attention of scientific men shall be drawn, by public encouragement, to further improvement.

"Many circumstances, however, must retard the general introduction of steam as a substitute for horse power on roads. One very formidable obstacle will arise from the prejudices which always beset a new invention, especially one which will at first appear detrimental to the interests of so many individuals. This difficulty can only be surmounted by a long course of successful, though probably unprofitable experiment. The great expense of the engines must retard the progress of such experiments. The projectors will, for a long period, work with caution, fearing not only the expense incurred by failure, but also that too sudden an exposure of their success would attract the attention of rivals. It is difficult to exemplify to the house how small and apparently unimportant an adaptation of the parts of the machinery, or of the mode of generating or applying the steam, may be the cause of the most rapid success; yet he who, by a long course of experiments, shall have first reached this point, may be unable to conceal the improvement, and others will at once reap the benefit of it.

"The committee are convinced, that the real merits of this invention are such, that it may be safely left to contend with these and similar difficulties; there are others, however, from which the legislature can alone relieve it. Tolls, to an amount which would utterly prohibit the introduction of steam carriages, have been imposed on some roads; on others, the trustees have adopted modes of apportioning the charge which would be found, if not absolutely prohibitory, at least to place such carriages in a very unfair position as compared with ordinary coaches.

"Two causes may be assigned for the imposition of such excessive tolls upon steam carriages. The first a determination on the part of the trustees, to obstruct, as much as possible, the use of steam as a propelling power; the second, and probably the more frequent, has been a misapprehension of their weight and effect on roads. Either cause appears to the committee a sufficient justification for their recommending to the house, that legislative protection should be extended to steam carriages with the least possible delay.

"It appears from the evidence that the first extensive trial of steam as an agent in draught on common roads, was that by Mr. Gurney, in 1829, who travelled from London to Bath, and back, in his steam carriage. He states, that although a part of the machinery which brings both the propelling wheels into action when the full power of the engine is required, was broken at the onset, yet that, on his return, he performed the last eighty-four miles, from Melksham to Cranford bridge, in ten hours, including stoppages. Mr. Gurney has given to the committee very full details of the form and power of his engine, which will be found in the evidence.

"The committee have also examined Messrs. Summers and Ogle, Mr. Hancock, and Mr. Stone, whose steam carriages have been in daily use for some months past on common roads. It is very satisfactory to find that, although the boilers of the several engines described, vary most materially in form, yet that each has been found fully to answer the expectation of its inventor. So well, in fact, have their experiments succeeded, that in each case where the proprietors have ceased to use them, it has only been for the purpose of constructing more perfect carriages, in order to engage more extensively in the business.

"When we consider that these trials have been made under the most unfavourable circumstances—at great expense—in total uncertainty—without any of those guides which experience has given to other branches of engineering—that those engaged in making them are persons looking solely to their own interests, and not theorists attempting the perfection of ingenious models—when we find them convinced after long experience, that they are introducing such a mode of conveyance as shall tempt the public, by its superior advantages, from the use of the admirable lines of coaches which have been generally established—it surely cannot be contended that the introduction of steam carriages on common roads is, as yet, an uncertain experiment, unworthy of legislative attention.

"Besides the carriages already described, Mr. Gurney has been informed that from 'twenty to forty others are being built by different persons, all of which have been occasioned by his decided journey in 1829.'

"The committee have great pleasure in drawing the attention of the house to the evidence of Mr. Farey. His opinions are the more valuable from his uniting, in so great a degree, scientific knowledge to a practical acquaintance with the subject under consideration. He states that he has 'no doubt whatever but that a steady perseverance in such trials will lead to the general adoption of steam carriages:' and again, 'that what has been done proves to his satisfaction the practicability of impelling stage coaches (by steam,) on good common roads, in tolerably level parts of the country, without horses, at a speed of eight or ten miles per hour.'

"Much, of course, must remain to be done in improving their efficiency; yet Mr. Gurney states that he has kept up steadily the rate of twelve miles per hour; that 'the extreme rate at which he has run is between twenty and thirty miles per hour.'

"Mr. Hancock 'reckons that, with his carriage he could keep up a speed of ten miles per hour, without injury to the machine.'

"Mr. Ogle states 'that his experimental carriage went from London to Southampton, in some places, at a velocity of from thirty-two to thirty-five miles per hour.'

"'That they have ascended a hill rising one in six, at sixteen and a half miles per hour, and four miles of the London road at the rate of twenty-four miles and a half per hour, loaded with people.'

"'That his engine is capable of carrying three tons weight, in addition to its own.'

"Mr. Summers adds, 'that they have travelled in the carriage at the rate of fifteen miles per hour, with nineteen persons on the carriage, up a hill one in twelve.'

"'That he has continued for four miles* and a half, to travel at the rate of thirty miles per hour.'

"'That he has found no difficulty of travelling over the worst and most hilly roads.'

"Mr. James Stone states that 'thirty-six persons have been carried on one steam carriage.'

"'That the engine drew five times its own weight nearly, at the rate of from five to six miles per hour, partly up an inclination.'

The several witnesses have estimated the probable saving of expense to the public, from the substitution of steam power for that of horses, at from one-half to two-thirds. Mr. Farey gives as his opinion, 'that steam coaches will, very soon after their first establishment, be run for one-third of the cost of the present stage coaches.'

"Perhaps one of the principal advantages resulting from the use of steam, will be, that it may be employed as cheaply at a quick as at a slow rate; 'this is one of the advantages over horse labour, which becomes more and more expensive as the speed is increased. There is every reason to expect that, in the end, the rate of travelling by steam will be much quicker than the utmost speed of travelling by horses; in short, the safety to travellers will become the limit to speed.' In horse draught the opposite result takes place; 'in all cases horses lose power of draught in a much greater proportion than they gain speed, and hence the work they do becomes more expensive as they go quicker.' On this and other points referred to in the report, the committee have great pleasure in drawing the attention of the house to the valuable evidences of Mr. Davies Gilbert.

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* In the original, "hours:" Mr. Summers states this to be a mistake, and directs the substitution which we have made.—Mech. Mag. March 1832, p. 443.
[Reviewer.]

"Without increase of cost, then, we shall obtain a power which will insure a rapidity of internal communication far beyond the utmost speed of horses in draught; and although the performance of these carriages may not have hitherto attained this point, when once it has been established, that at equal speed we can use steam more cheaply in draught than horses, we may fairly anticipate that every day's increased experience in the management of the engines, will induce greater skill, greater confidence, and greater speed.

"The cheapness of the conveyance will probably be for some time a secondary consideration. If at present it can be used as cheaply as horse power, the competition with the former modes of conveyance will first take place as to speed. When once the superiority of steam carriages shall have been fully established, competition will induce economy in the cost of working them. The evidence, however, of Mr. Macneil, showing the greater efficiency, with diminished expenditure of fuel, by locomotive engines on rail-ways, convinces the committee that experience will soon teach a better construction of the engines, and a less costly mode of generating the requisite supply of steam.

"Nor are the advantages of steam power confined to the greater velocity attained, or to its greater cheapness than horse draught. In the latter, danger is increased, in as large a proportion as expense, by greater speed. In steam power, on the contrary, 'there is no danger of being run away with, and that of being overturned is greatly diminished. It is difficult to control four such horses as can draw a heavy carriage ten miles per hour, in case they are frightened or choose to run away; and for quick travelling they must be kept in that state of courage, that they are always inclined for running away, particularly down hills and at sharp turns of the road. In steam, however, there is little corresponding danger, being perfectly controllable, and capable of exerting its power in reverse in going down hills.' Every witness examined has given the fullest and most satisfactory evidence of the perfect control which the conductor has over the movement of the carriage. With the slightest exertion it can be stopped or turned, under circumstances where horses would be totally unmanageable.

"The committee have, throughout their examinations, been most anxious to ascertain whether the apprehension very commonly entertained, that an extensive use of these carriages on roads would be the cause of frequent accidents and continued annoyance to the public, were well founded.

"The danger arising from the use of steam carriages, was stated to be two-fold; that to which passengers are exposed from explosion of the boiler, and the breaking of the machinery, and the effect produced on horses by the noise and appearance of the engine.

"Steam has been applied as a power in draught in two ways: in the one, both passengers and engine are placed on the same carriage; in the other, the engine carriage is merely used to draw the carriage in which the load is conveyed. In either case, the probability of danger from explosion has been rendered infinitely small, from the judicious construction of boiler which has been adopted.

"These boilers expose a very considerable surface to the fire, and steam is generated with the greatest rapidity. From their peculiar form, the requisite supply of steam depends on its continued and rapid formation; no large and dangerous quantity can at any time be collected. Should the safety valve be stopped, and the supply of steam be kept up in a greater abundance than the engines require, explosion may take place, but the danger would be comparatively trifling, from the small quantity of steam which could act on any one portion of the boiler. As an engine, invented by Mr. Trevithick, has not been as yet applied to carriages, the committee can do no more than draw the attention of the house to the ingenuity of its contrivance. Should it ' practice be found to answer his expectation, it will remove entirely all danger from explosion. In each of the carriages described to the committee, the boilers have been proved to a considerably greater pressure than they can ever have to sustain.

" Mr. Farey considers that 'the danger of explosion is less than the danger attendant on the use of horses in draught; that the danger in these boilers is less than in those employed on the railway, although there even, the instances of explosion have been very rare.' The danger arising to passengers from the breaking of the machinery, need scarcely be taken into consideration. It is a mere question of delay, and can scarcely exceed in frequency the casualties which may occur with horses.

" It has been frequently urged against these carriages, that wherever they shall be introduced, they must effectually prevent all other travelling on the road, as no horse will bear quietly the noise and smoke of the engine.

" The committee believe that these statements are unfounded. Whatever noise may be complained of, arises from the present defective construction of the machinery, and will be corrected as the makers of such carriages gain greater experience. Admitting even that the present engines do work with some noise, the effect on horses has been greatly exaggerated. All the witnesses accustomed to travel in these carriages, even on the crowded roads adjacent to the metropolis, have stated that horses are very seldom frightened in passing. Mr. Farey and Mr. Macneil have given even more favourable evidence in respect to the little annoyance they create.

"No smoke need arise from such engines. Coke is usually burned in locomotive engines, on rail-ways, to obviate this annoyance; and those steam carriages which have been hitherto established also burn it. Their liability to be indicted as nuisances will sufficiently check their using any offensive fuel.

" There is no reason to fear that waste steam will cause much annoyance. In Mr. Hancock's engine it passes into the fire, and in other locomotive engines it is used in aid of the power, by creating a quicker draught and more rapid combustion of the fuel. In Mr. Trevithick's engine it will be returned into the boiler.

" The committee not having received evidence that gas has been practically employed in propelling carriages on common roads, have not considered it expedient to inquire as to the progress made by several very scientific persons who are engaged in making experiments on gases, with the view of procuring a still cheaper and more efficient power than steam.

" The committee having satisfied themselves that steam has been successfully adopted as a substitute for horse power on roads, proceeded to examine whether tolls have been imposed on carriages thus propelled, so excessive as to require legislative interference, and also to consider the rate of tolls by which steam carriages should be brought to contribute, in fair proportion with other carriages, to the maintainance of the roads on which they may be used.

" They have annexed a list of those local acts in which tolls have been placed on steam, or mechanically propelled carriages.

" Mr. Gurney has given the following specimens of the oppressive rates of tolls adopted in several of these acts: On the Liverpool and Prescot road, Mr. Gurney's carriage would be charged £2 8s. while a loaded stage coach would pay only 4s. On the Bathgate road the same carriage would be charged £1 7s. 1d., while a coach drawn by four horses would pay 5s. On the Ashburnham and Totness road Mr. Gurney would have to pay £2, while a coach drawn by four horses would be charged only 3s. On the Teignmouth and Dawlish roads the proportion is 12s. to 2s.

" Such exorbitant tolls on steam carriages can only be justified on the following grounds:

" First, because the number of passengers conveyed on, or by, a steam carriage will be so great as to diminish (at least the extent of the difference of the rate of toll,) the total number of carriages used on the road; or, secondly, because steam carriages induce additional expense in the repairs of the road.

"The committee see no reason to suppose that, for the present, the substitution of steam carriages, conveying a greater number of persons than common coaches, will take place to any very material extent; and, as to the second cause of increased charge, the trustees, in framing their tolls, have probably not minutely calculated the amount of injury to roads likely to arise from them.

"The committee are of opinion that the only ground on which a fair claim to toll can be made on any public road, is to raise a fund which, with the strictest economy, shall be just sufficient, first, to repay the expense of its original formation; secondly, to maintain it in good and sufficient repair.

"Although the committee anticipate that the time is not far distant when, in framing a scheme of toll for steam carriages, their general adoption, and the great number of passengers which will be conveyed on a small number of vehicles, will render it necessary not only to consider the amount of injury actually done to the road, but also the amount of debt which may have been incurred for its formation and maintenance; yet at present they feel justified by the limited number of such carriages, and by the great difficulties they will have to encounter, in recommending to the house, that in adopting a system of toll, the proportion of 'wear and tear' of roads by steam, as compared with other carriages, should alone be taken into consideration.

"Unless an experiment were instituted on two roads, the one reserved solely for the use of steam coaches, the other for carriages drawn by horses, for the purpose of ascertaining accurately the relative wear of each, it would be quite impossible to fix with certainty the proportion of tolls to which, on the same road, each class of vehicles should be liable. To approximate, however, as nearly as possible to the standard of relative wear, the committee have compared the weights of steam carriages with those of loaded vans and stage coaches. They have tried to ascertain the causes of the wear of roads; also the proportion of injury done by the feet of horses and the wheels of coaches; how far that injury is increased by increased velocity, and also in what degree the wear of roads by loaded carriages may be decreased by any particular form of wheel.

"The committee would direct the attention of the house especially to the evidence of Mr. Macneil, whose observations on this branch of the subject, being founded on a long course of very accurate experiment, are peculiarly interesting and useful. He estimates that the feet of horses drawing a fast coach, are more injurious to the road than the wheels, in the proportion of three to one, nearly; that this proportion will increase with the velocity; that by increasing the breadth of the tires of the wheels, the injury done to roads by great weights may be counteracted. He considers that, on a good road, one ton may be safely carried on each inch of width of tire of the wheels.

"Mr. M'Adam and Mr. Telford have given corresponding evidence as to the greater wear caused by horses' feet, than by wheels of carriages.

"Each of the above witnesses agrees, that adding the weight of the horses to that of the coach, and comparing the injury done to a road by a steam carriage of a weight equal to that of the coach and horses, (the wheels being of a proper width of tire,) the deterioration of the road will be much less by the steam carriage than by the coach and horses.

"As to the injury to roads which is anticipated from the 'slipping' of the wheels, it may safely be left to the proprietors to correct: the action of the wheel slipping involves a waste of power, and a useless expenditure of fuel, which, for their own sakes, they will avoid.

"Apprehension has also been entertained that, although the peculiar action of the wheels may not be injurious, yet that, from the great power which may be applied if the steam were worked at very high pressure, or if the size of the engine were increased, greater weight might be carried than the strength of the road could bear.

"Undoubtedly, in proportion to the advance of the science, will be the increase of weight drawn by an engine with a given expenditure of fuel; but there are many practical difficulties to be surmounted before the weight so drawn can reach the point when it could be destructive of roads. There are no theoretical reasons against the extension of the size of the engines. The difficulties, according to Mr. Gurney, are of a practical nature, and only in the 'difficulty of management of a large engine.' In proportion as we augment the power of the engines, we must increase their strength, and consequently their weight; the greater weight will be a material diminution of their efficiency. To a certain extent the power may be increased in a greater ratio than the weight, but with our limited knowledge of the application of steam, and with the present formation of the public roads, the point will be very soon attained, when the advantage of increased power will be counterbalanced by the difficulties attendant on the increased weight of the engines.

"The weight of the steam carriages at present in use, varies from 53 to 80 cwt.; but it must be recollected that they are mere models; they were made with attention to strength only, to bear the uncertain strain to which they would be exposed in the course of experiments, and a very considerable diminution of weight may be anticipated.

"The weight drawn, at the rate of ten miles per hour, by Mr. Gurney's engine, has not, on any extent of road, exceeded the weight of the drawing carriage; nor is it likely, with the difficulties to be encountered on the present lines of road, from their quality and the numerous ascents, that the weight drawn will be in excess of the strength of the roads. The immense quantity of spare power required to surmount the different degrees of resistance likely to occur, would render the engine too unmanageable. This will appear evident from the force of traction required to draw a wagon over the Holyhead and Shrewsbury road, which varied from 40 to upwards of 300 lbs.

"In considering the effect on roads, we must not overlook one peculiarity in which they have a great advantage over other carriages. In coaches drawn by horses, the power being without the machine to be removed, it becomes an object of the greatest importance to give as much effect as possible to the power, by diminishing the resistance arising from the friction of the wheels upon the surface of the road. For this purpose, the proprietors of coaches and wagons have adopted every possible contrivance, so to reduce the tires of their wheels, that a very small portion of them may press on the road; in some coaches they are made circular in their cross section, so that the entire weight of the carriage presses on a mere point; should the materials be soft, such wheels cut their way into the road like a sharp instrument. The owners of wagons too have adopted a similar plan. Mr. Macneil states that the actual bearing part of the tire of apparently broad wheeled wagons, is reduced to three inches by the contrivance of one band of the tire projecting beyond the others.

"With steam, on the contrary, a certain amount of adhesion to the roads is required to give effect to the action of the machinery, or the wheels would slip round and make no progress. It appears of little importance, therefore, so far as relates to the engine, whether the requisite amount of friction be spread over a broad surface of tire, or be concentrated to a small point; but as the wheels, by being too narrow, would have a tendency to bury themselves in every soft or newly made road, and thus raise a perpetual resistance to their own progress, it actually becomes an advantage to adopt that form which is least injurious to the road. The proprietors, who have been examined on this point, seem to be quite indifferent as to the breadth of tire they may be required to use.

"These considerations have convinced the committee, that the tolls enforced on steam carriages have, in general, far exceeded the rate which their injuriousness to roads, in comparison with other carriages, would warrant; they have found, however, considerable difficulty in framing a scale of tolls applicable to all roads, in lieu of those authorized by several local acts.

"With this view they have carefully examined the various modes of imposing toll, either suggested by the witnesses or already adopted.

"They are as follows:

"1. To place a toll proportioned to the weight of the carriage and load.

"2. On the number of passengers.

"3. On the horse power of the engine.

"4. On the number of wheels.

"5. An unvarying toll.

"Each of these plans seems liable to serious objections, which the committee beg to submit to the house.

"No plan of toll has been more frequently recommended than that of a charge in proportion to the weight of the engine and load. As this is the most plausible, and (if it could be levied without other disadvantages,) would probably be the fairest standard, the committee have considered it right to state, at some length, their reasons for not recommending its adoption.

"If weight be taken as the standard, the toll must be a fixed charge, either upon the weight of the engine and carriage, without reference to the load; or upon an estimated average of the load carried; or a fluctuating charge, according to the weight, at the several periods of a journey.

"The first would be at least free from the uncertainty of the other two, and therefore would be preferable; but what scale of charge per cwt. could the committee recommend as applicable to all roads? Their toll should vary according to every different rate of charge on carriages; besides, it would appear to the trustees very unjust to exclude the consideration of that which would be deemed the most material cause of the wear of their roads; viz. the load.

"A fluctuating charge on weight would be most injurious to a carriage which will mainly depend for success on its speed; constant altercations would take place between the toll collectors and proprietors; a minute calculation would be required at every turnpike gate; in fact, unless an accountant were placed at each, the committee cannot conceive how the proportions could be satisfactorily arranged, nor would there be any desire, on the part of the toll collector, to shorten the delay occasioned by these interruptions.

"Mr. Gurney has delivered in a scale of tolls graduated according to weight and width of tire of the wheel. As this has been drawn up by a person interested in the success of steam carriages, it might have been expected to be more favourable to them. The committee, however, have not adopted it, because of the difficulties and interruptions which a fluctuating rate of toll would induce; besides, this scale purports to be intended for a road where 3d. is charged for a horse drawing, and 1d. for a horse not drawing; the scale would be inapplicable therefore when the charge was 2d. and 1d., 3d. and 1½d., 4d. and 1d., 4d. and 1½d., 8d. and so on. Again, what standard of weight, in relation to horse coaches, could be adopted? The average weight of loaded coaches differs very much on different roads. It has been suggested, that a loaded coach, including the weight of four horses, would weigh on an average four tons; and that if 6d. per horse were chargeable to the coach, 6d. per ton should be placed on a steam carriage; this would be unjust, as vans, which frequently weigh upwards of six tons, would only pay 2s., and a steam carriage would pay 3s. Even if the injury done to the road by each were equal, this would be an unfair toll; but it will appear more evidently unjust if the greater proportionate injury done by the feet of horses drawing, than by the propelling wheels, be taken into consideration.

"The object of every steam coach proprietor will be to attain the greatest possible lightness of machinery and engine; because thereby he renders his power more efficient for the draught of the remunerating load. To place the toll on the weight of the engine would tend to induce him to decrease the strength of his boiler and machinery to an extent which might be dangerous to the passengers, and very detrimental to the success of steam travelling, as the public will easily be led to believe that the accidents really occurring from injudicious legislation, were inseparable from the adoption of this power as an agent in propelling carriages.

"The only fair plea for charging tolls on such carriages in proportion to their weight, is to prevent a load being propelled or carried which would permanently injure the road; within this limit it would be as injudicious to interfere with their progressive efficiency, (which can only result from improvements of the machinery and the system of generating and applying steam,) as it would be to tax carriages drawn by large and well-bred horses, more heavily than such as were drawn by horses in worse condition, and of smaller size and power.

"The roads at present have to sustain wagons, weighing, at times, with their horses, nearly ten tons; it is in evidence, that the breadth of wheels required by various acts of Parliament, is so easily evaded, that it affords no protection to the road. There appears to the committee no fair reason to suppose that steam carriages, approaching even to this weight, will be used on any turnpike road, at least for a very considerable period, during which the increase of weight will be gradual, and will give warning to the legislature when it should interfere.

"To charge a toll according to the number of passengers conveyed, is scarcely less objectionable. If a fluctuating toll be intended, it would be as inadmissible as to propose a similar mode of charging for fast coaches, and would be open to all the cavil and interruptions to which a fluctuating toll on weight would be liable. If the toll were fixed according to the number of passengers the carriage were capable of conveying, it would imply the necessity of a license limiting the number of passengers, and cramping the progress of improvement of a machine, the capabilities of which can only be ascertained slowly and by continued experiment.

"It must be also recollected that these carriages will probably have to travel for a long period without passengers, until by their punctuality and safety they shall have induced the public to venture in them. Nor is this probability weakened by the immense number of passengers who commenced using the locomotive carriages on the Manchester and Liverpool rail-way immediately after their introduction: these engines were established among a population accustomed to machinery and steam, and therefore not entertaining the same apprehensions of its danger which will require to be surmounted elsewhere.

"The trustees of the Liverpool and Prescot road have already obtained the sanction of the legislature to charge the monstrous toll of 1s. 6d. per 'horse-power,' as if it were a national object to prevent the possibility of such engines being used. Besides, they have supplied no standard of their own conception of horse power. Engineers have differed very much in their estimates of this power; there is not, therefore, much probability that the opposite interests of a steam coach proprietor and toll collector would lead to any agreement as to the meaning of the term. But suppose the legislature were to settle this point, and to arrange that a certain length of stroke and diameter of cylinder should represent a certain power, we still fail to ascertain that which alone it is essential to know, viz. the actual efficiency of the engine. Can we regulate the density of steam at which an engine of a given size should be worked? To be effectual, it would be also necessary to ascertain the quantity of water consumed, and even this check would be inadequate with an engine on Mr. Trevithick's principle. If the toll be left as at present on 'horse power,' it would be the obvious interest of the proprietor to work with the smallest nominal power, but to increase as much as possible the force of his steam, thereby increasing the probability of explosion.

"Some trustees have placed the toll upon the number of wheels. The committee would object to this mode of charge, if only because it interferes between the rival modes of steam travelling, and gives a bounty in favour of that in which the engine is placed on the same carriage with the passengers. The opposite plan of separating the engine from the carriage is that which probably the public will prefer, until the safety of the mode of conveyance shall have been fully ascertained.

"There is still a more serious objection to this mode of charge: it tends to discourage the use of separate carriages; although it must be evident that if a certain weight be carried it will be much less injurious to the road when divided over eight wheels, than when carried on only four. On this point the committee must again refer to Mr. Macneil's evidence. They cannot, therefore, recommend the house to adopt a scale of toll which shall increase in inverse proportion to the injury done to the road. It will be seen in Mr. M'Adam's evidence, that the toll on steam coaches imposed by the metropolitan roads act, is liable to this objection.

"Some of the local acts have placed an unvarying toll on steam carriages. This, if moderate, would be unobjectionable; but the committee could not propose any sum which would adapt itself to the necessary varieties of expense in keeping up different roads, by which the tolls on common carriages have been regulated. A fixed toll has, too, this disadvantage: that light experimental carriages, or such as are built solely for speed, would be liable to the same toll as steam carriages heavily laden.

"The committee feel that, however strong their conviction may be of the comparatively small injury which properly constructed steam carriages will do to the roads, yet this conviction is founded more on theory, and perhaps what may be considered as interested evidence, than practical experience; they would therefore recommend that the house should not make, at present, any permanent regulations in favour of steam. The experience which will be gained in a very few years, will enable the legislature to form a more correct judgment of the effect of steam carriages on roads than can be now made. They therefore recommend that the *tolls* imposed on steam carriages by local acts, where they shall be unfavourable to steam, shall be suspended during *three years;* and that, in lieu thereof, the trustees shall be permitted to charge toll according to the rate to which the committee have agreed.

"The house will have perceived, in the former part of this report, that there are two modes of applying steam in lieu of horses in draught: one, where the engine and passengers are on the same carriage; the other where the engine is placed on separate wheels, and is merely used to propel or draw the carriage. Although the difference of weight may be in favour of the former mode, yet, as on the latter it is divided over eight wheels instead of four, its small excess cannot justify a larger toll being imposed, as it will be found much less injurious to the roads. The committee therefore recommend that, in charging toll, the engine carriage and carriage drawn shall be considered but as one.

"As it is the opinion of all the engineers examined, that the use of narrow wheels has been the great cause of the wear of roads, and that cylindrical wheels of certain width of tire, are not only the least injurious, but that, in some states of the road, they may be even beneficial, the committee recommend that the wheels of the engine carriage should be required to be cylindrical, and of not less than three and a half inches width of tire. No proprietor of steam carriages has expressed the slightest fear of any inconvenience or loss from the use of such wheels. Beyond this, the committee would not recommend interference with the breadth of tire, or form of wheels: it should be left to the proprietors freely to select the breadth of tire they shall find most convenient in proportion to the weight carried.

"The committee have divided steam carriages (intended for passengers) into two classes, to be subject to different rates of toll. The first, where the carriage is not plying for hire, or where, if plying for hire, it shall not be calculated for, or carry at any time, more than six passengers. The original cost of such machines, and the expense of working them, will sufficiently protect the roads from any great number of merely experimental carriages; and for the same reason they will not be of a weight or size likely to be injurious. A steam carriage only calculated to convey six passengers, will be solely used where great speed is required, and will be so light as to cause very little wear of the road, probably much less than many carriages drawn by the number of horses which the committee recommend as the standard of charge for this class. The toll, therefore, proposed to be placed on this class of steam carriages, is that which (on the several roads where they may be used) is charged on a carriage drawn by two horses.

"In the second class, they have placed all other steam carriages, except those travelling at slow rates, for goods only: carriages of this class should pay the same toll as may be charged on a coach drawn by four horses. This may at first appear unjust from the supposed power of steam to draw almost unlimited weight. The committee have already enumerated the difficulties hitherto encountered in attempting to propel very heavy loads on turnpike roads. They are such as to discourage the expectation that, within any short period of time, the system will have been so perfected as to give rise to inconvenience from this source; should any hereafter be found it will then be sufficient to remedy the defect. Until a due proportion of the parts of the machinery shall have been ascertained, the makers of these carriages will vary but cautiously from the models at present in use: their object will be, for some time, the perfecting of them, rather than the uncertain experiment of increasing their size.

"The committee do not anticipate that, for a considerable period, steam will be used as a propelling power on common roads for heavy wagons. It appears to have been the general opinion of the witnesses, that, in proportion as the velocity of travelling by steam on common roads is diminished, the advantages of steam over horse power are lost. The efficiency of horses in draught is rapidly diminished as their speed is increased; while, on the contrary, the weight which could be carried or propelled at any great velocity by steam, could not be more cheaply conveyed were the speed decreased to that of the slowest wagon.

"As speed, therefore, is the cause of greatly increased expense where horses are used, while with steam it is comparatively unimportant, it is probable that the latter will be chiefly resorted to when rapidity of conveyance is required. Mr. Gurney considers, that, under four miles per hour, horses can be used in draught more economically than steam. Should it, however, be deemed profitable to convey heavy goods by steam carriages, the committee recommend that there should be as little interference as possible with the number of carts employed; as the effect on the surface of roads would be infinitely more injurious if heavy loads were placed on a single cart, than if the same weight were divided over several. The committee recommend, that where carriages, containing heavy goods alone, are propelled by steam, the weight of the load should be charged, without reference to the number of carts on which it may be carried.

"As a horse is able to draw from twenty to forty cwt. on common roads, they propose that each twenty cwt. of load, conveyed in, or drawn by a steam carriage, should be chargeable at the same rate of toll as one horse drawing a cart.

"A charge on weight is not so objectionable where goods are conveyed at a slow rate, as when speed is alone required.

"In conclusion, the committee submit the following summary of the evidence given by the several witnesses, as to the progress made in the application of steam to the purposes of draught on common roads.

"Sufficient evidence has been adduced to convince your committee—

"1. That carriages can be propelled by steam on common roads at an average rate of ten miles per hour.

"2. That at this rate they have conveyed upwards of fourteen passengers.

"3. That their weight, including engine, fuel, water and attendants, may be under three tons.

"4. That they can ascend and descend hills of considerable inclination with facility and safety.

"5. That they are perfectly safe for passengers.

"6. That they are not (or need not be, if properly constructed) nuisances to the public.

"7. That they will become a speedier and cheaper mode of conveyance than carriages drawn by horses.

"8. That as they admit of greater breadth of tire than other carriages, and as the roads are not acted on so injuriously as by the feet of horses in common draught, such carriages will cause less wear of roads than coaches drawn by horses.

"9. That rates of toll have been imposed on steam carriages, which would prohibit their being used on several lines of road, were such charges permitted to remain unaltered."

The following bill, introduced in accordance with the views expressed in the foregoing report is extracted from the Mechanics' Magazine for March last.

Bill to regulate the Turnpike Toll on Steam Carriages.

"Whereas, of late years there has been invented an application of the power derived from steam to the propelling of carriages along the roads of this kingdom, and such invention is likely to become very beneficial to the public: And whereas in the absence of a just knowledge of the effect produced upon roads by carriages so propelled, and under a notion that such carriages would be more detrimental to the roads, and occasion greater inconvenience to travellers, than other carriages drawn by horses, various local acts of Parliament have been passed, imposing excessive tolls upon carriages propelled by steam or other elemental or mechanical power, amounting in some instances to a prohibition of the use of the said invention: And whereas the greater number of all the other acts of parliament whereunder tolls upon the roads and bridges of the united kingdom are collected, were passed before the said discovery was made, and by such acts no toll is imposed on any carriage so propelled as aforesaid; nor until such several acts shall be amended, or a provision in regard to the said insufficiency of such acts shall otherwise be made by parliament, can any tolls whatsoever upon carriages so propelled along the several roads or over the bridges to which such acts respectively relate be lawfully demanded; whereby in such instances the proprietors of carriages so propelled avoid contributing their fair proportion of the expense of maintaining the said roads and bridges: And whereas the public ought not to be so precluded from benefitting by the said invention, and all such legislative obstructions to the further improvement of this application of steam, and to a free and extensive adoption of it, should for a limited time be suspended; and also, throughout the realm a reasonable toll should be paid in respect of every carriage so propelled along the said roads or over the said bridges;—be it therefore enacted, by the king's most excellent majesty, by and with the advice and consent of the lords, spiritual and temporal, and commons, in this present parliament assembled, and by the authority of the same, That throughout the united kingdom of Great Britain and Ireland, from and after the *first day of July next following the passing of this act*, all and every toll and tolls imposed by any turnpike or other act of parliament whatsoever upon any carriage propelled by any means or power other than animal power, by whatsoever name or description such carriage shall be called or known, shall cease during the continuance of this act, and not be collected.

"And be it further enacted, that from and after the day aforesaid, the tolls mentioned and set forth in the schedule to this act annexed, and no other tolls whatsoever shall be collected or taken on any carriage, by what name or description whatsoever the same shall be called or known, which shall be propelled by means of steam or other elemental or mechanical power, or by any power other than animal power, along any road or over any bridge whatsoever, in any part of the united kingdom. Provided always, that nothing in this act shall authorize any such toll to be collected in respect of any carriage so propelled along any such road or over any such bridge, unless and during such time only, and at such place or places only, as tolls upon carriages drawn by horses, whether such carriages drawn by horses shall be coaches, stage-coaches, chaises, post chaises, wagons, carts, or carriages of other names or descriptions, along such road or over such bridge, shall by law be receivable.

"And be it further enacted, that where the tolls on carriages drawn by horses shall expire, or otherwise be no longer receivable, there also the aforesaid tolls on propelled carriages shall likewise cease, and be no longer receivable.

"And be it enacted, that no toll shall be collected upon any propelled carriage, which carriage shall belong to or be in the employment of his majesty or any of the royal family, or being employed in conveying the mails or king's stores, or officers or men in the army, including yeomanry and volunteers, or the navy on service, or in carrying agricultural produce to or from market or sale, or in taking persons to or from church, or a funeral, or a county election, or on carrying the surveyor of the road, or in the transmission of vagrants.

"And be it further enacted, that if after the commencement of this act, any toll-taker or other person shall take or shall demand any toll upon any carriage so propelled, other than the toll imposed by this act, he shall for every toll so taken or so demanded forfeit and pay the sum of *five pounds*, one half thereof to our lord the king, and the other half to him that will sue for the same, to be recovered in an action of debt in any court of record in the united kingdom, with full costs of suit. Provided always, that such action shall be commenced within *ninety* days after the day of taking such toll.

And be it further enacted, that this act shall commence from *twelve* of the clock at noon of the *first day of July* next, and shall continue in force from that day during *five years*, and to the end of the then next session of parliament."

Schedule of Tolls payable on Steam Carriages, or Carriages propelled by any means other than Animal Power.

"Where any such carriage is not plying for hire, or if plying for hire shall carry not more than *six* passengers, the like toll as shall be payable in respect of a four-wheeled coach drawn by two horses; and if carrying a greater number of passengers than *six*, the like toll as shall be payable in respect of a four-wheeled coach drawn by four horses.

"And when the tire of the wheels of such carriage shall be less than three inches and a half in width, or have a greater degree of convexity than half an inch; the toll to be taken on such carriage shall be *double* the aforesaid tolls respectively.

"Where any such propelled carriage shall be used in the place of a wagon or cart for conveying goods or other things, and the load shall not exceed *one ton of twenty hundred weight*, the like toll as shall be payable for a single horse drawing a cart; and for every further ton or fraction of a ton, a further toll of the like amount.

"And where the engine carriage shall be a separate carriage from the first train-carriage conveying passengers or goods, the engine carriage shall not be charged separately, but one toll only shall be taken for both carriages.

"And where the engine carriage shall draw more than one train carriage, then for every train carriage after the first train carriage, a further toll of *one half* of the single toll shall be taken, and no more."

[TO BE CONTINUED.]

TRANSLATIONS FROM FOREIGN JOURNALS.

[Translated for this Journal.*]

On the Bleaching Powers of Alkaline Chlorides.

Welter found that the liquid resulting from the absorption of a certain bulk of chlorine, by an alkaline solution, possessed the same bleaching power as the chlorine itself. This is true of the bleaching effects, as shown by a solution of sulphate of indigo; the chlorine being disengaged from the solution which has absorbed it. The same is not true of the bleaching effects upon solutions which are not acid. I made a solution of a known volume of chlorine in water, and of the same volume in a weak solution of carbonate of soda. The bleaching effects of these two solutions appeared to be the same by the test of sulphate of indigo. With colouring matter containing no acid, the alkaline solution always proved the less powerful. The bleaching power of the solution of any chloride, is much increased by adding an acid, which confirms the above remarks.

By using a solution of ink, which was not acid, I found the relative bleaching powers of chlorine and of chloride of soda, to be as 1.62 to 1. The colouring matter from the petals of the red poppy, gave a ratio of 1.66 to 1.

It should be observed that when a chloride has produced its appropriate effects, the action of an acid cannot increase them.

I will not leave this subject without observing first, that the bleaching power of a chloride as usually determined, is not that of the chloride itself, but of the chlorine used in producing it. Second, that the presence of an acid augments the bleaching powers of a chloride. These remarks may serve to explain certain facts observed in the bleaching, &c. of printed stuffs. (Soubeiran, Recherches sur quelques combinaisons de chlore.)

[*Ann. de Chim. et Phys. Oct.*, 1831.

ROYAL ORDINANCES OF FRANCE RELATING TO STEAM-BOATS.

(Continued from p. 110.)

I. Of the Superintendence and Management of the Engine.

1. The *permit* of navigation is to be granted only on the express condition that on board of every boat, intended for the reception of passengers, there shall be a person whose constant business it shall be to superintend the engine, and who must have sufficient skill to keep it always in order, to know when it works well in all its parts, and, if needed, to repair it.

2. The duties of this engineer cannot be entrusted to the fireman, who is to be under the direction of the engineer.

3. The engineer must observe all the ordinary measures of precaution prescribed by the ministerial instructions of 19th March,

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* By request of the Committee on Publications.

1824; and to this end, these instructions ought to be hung up near the engine.

II. Of the Supply of Water within the Boiler.

4. To enable the engineer to determine that the supply of water to the boiler is sufficient to compensate for the water used in producing steam, for working the engine or to supply waste, and that thus the surface of the water in the boiler is kept at a constant level above the flues within; two gauge tubes of glass must be adapted (besides the ordinary floats) to the boiler, and must be constantly kept in a sound condition. In the adjustment of these tubes, regard must be had to the effects of dilatation by heat.

Each of these tubes is to be fitted vertically between two horizontal copper tubes, which are provided with stop cocks, and which communicate with the interior of the boiler, one above and the other below the water line, so that the water will stand at the same height in the glass tubes as in the boiler.

Several of these tubes must be kept at hand, so that if those on the boiler should be broken, they may, immediately, be replaced.

The same purpose may be answered by three gauge cocks, which must be placed thus: the first, at the ordinary level of the water, the second a little above, and the third a little below the same. But the use of glass tubes is to be preferred in river navigation.

5. A safety tube, terminated by an organ pipe, should be adjusted to the boiler, and so disposed that if, from any unforeseen cause, the surface of the water in the boiler should fall below the proper level, the steam escaping through this pipe would produce a noise, giving notice of the danger and the necessity of instantly remedying it.*

III. Of the Safety Valves.

6. The engineer ought to be careful that the safety valves are in good order.

7. The safety valves of high pressure engines must be loaded by means of a lever, those of low pressure engines directly.

Overloading the safety valves is expressly prohibited.

8. The weight on the safety valve is to be determined in pounds and fractions of a pound according to the number of the stamp of the boiler.

If the boiler be a low pressure one, and terminated with plane ends, (in which case, not having been proved, it cannot be stamped,) the safety valves must be loaded directly, with a weight equivalent at most to half an atmosphere, that is, with a weight of seven and a half pounds to every square inch.

IV. Of the Fusible Metallic Plates.

9. It is expressly forbidden to use metallic plates not corresponding

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* The reader will perceive that several of these regulations could not be applied, in practice, to the boilers of high pressure engines, working at the pressure used in this country.—Trans.

in their fusing point to the number on the stamp of the boiler, or to endeavour, by any means whatever, to prevent the fusion of the plates.

10. Covers are ordered to be placed over the plates (not, however, to be fastened down) which will preserve them from injury, and prevent the access of water or any foreign substance; at the same time, inspection must be easy, that the number of their stamp may be made out at first sight.

11. A number of metallic plates must be kept constantly on hand in every boat, so that those which may melt may be instantly replaced.

V. Of the Steam Gauges.

12. A mercurial gauge must be adapted to every boiler. It must be constructed with care, and graduated with exactness.

13. An open gauge must always be used for low pressure boilers, and as far as possible for high pressure boilers also. This gauge is much to be preferred to the short gauge closed at top and containing a column of air.

14. The necessary precautions should be used to preserve this instrument from injury; but there must always be at hand a gauge, beside the one on the boiler, to take the place of the latter in case of accident.

VI. Of the management of the Fire and of the Engine.

15. The engineer must see that the fireman manages the fire with the greatest regularity, and observes all the precautions pointed out in the ministerial instructions of 19th March, 1824, which must, for this purpose, be hung up somewhere near the engine, as has been already directed.

16. When the boat approaches a stopping place, the captain must give notice of the fact to the engineer and the fireman, that the latter may cease to urge the fire.

If, when the boat is not in motion, the column of mercury in the steam gauge should continue to rise, the engineer must let off the steam.

17. If the level of the water within the boiler should be depressed too much, and the boiler become red hot in parts, the engine must be stopped to introduce water into the boiler, and the steam should be allowed to escape only through the safety valve, or through a discharge cock.

In such a case it will be necessary to put out the fire, and allow the boiler to cool down, before water is introduced.

VII. Of the Internal Police of Steam-boats.

18. Captains are expressly forbidden to run their boats at a speed greater than that given by the regular working pressure of the engine, under penalty of being personally responsible for any accident which may occur in consequence of such conduct.

19. There shall be kept open, in every steam-boat, a register, the contents of which shall be examined by the local authorities and transferred to their notes. Upon this register the passengers shall have an opportunity to note their observations in relation to the going of the boat, and to accidents, if any, which may have occurred.

20. These registers shall be submitted for inspection to the committees of superintendence, whenever they visit the boat; and to the authorities charged with local arrangements in the communes situated along the water course, whenever these authorities wish to see them.

21. In every house for the reception of passengers, there should be hung up a notice, on which should be stated:

1st. The mean duration of the passage, both in going up and coming down, allowance being made for the current.

2nd. The time that the boat is to remain at the landing places.

3d. The greatest number of passengers the boat may carry.

4th. The right which passengers have to note their observations on the register opened for that purpose in the boat.

22. Captains are bound, after each trip, to declare to the local authorities all the facts which come to their knowledge, likely to be of interest to the safety of the navigation, so that measures may be taken, if necessary, in relation to them.

23. Lastly, the local regulations should specify the working pressure of every engine, the number of the stamp on the boiler, the proper load for the safety valves, the melting points of the fusible plates used, and the height of the mercury in the gauge, corresponding to the ordinary working pressure.

Said regulations must also embrace all the measures of local interest which the Prefects think proper to prescribe for the regulation of steam navigation; they must also contain an enumeration of the cases in which the *permit* of navigation may on account of violation of the regulations, be withdrawn, for a longer or shorter time. They should mention, also, that according to articles 319 and 320, of the penal code, the proprietors of boats are liable to criminal prosecution for accidents which may have arisen from their negligence, imprudence, or want of attention to the regulations, and that too without prejudice to the damages which they may have incurred.

The observance of the regulations imposed on the proprietors of steam-boats should be carefully attended to, not only by the committees of superintendence, but also by the engineers of mines, government civil engineers, officers of the ports, mayors, and adjuncts, commissaries of police and officers and sub-officers of gendarmerie, in the cities and communes situated on the lines of navigation.

It is the duty of officers in their several stations to report to the Prefects all infractions of regulations, and all accidents.

On the receipt of such reports, the Prefect having first examined into the charges contained in them, shall take such measures as he thinks proper to bring the offenders to justice.

If it happen that an infraction occurs in a different department from that in which the *permit* of navigation was granted, the Prefect of the former department shall transmit the charges to his colleague in the department where the permit was granted, to be acted upon by the latter.

It is of importance that the visits of the committee of superintendence be made very frequently, and not only when the boats are *at the wharf*, but also when they are on the passage. The report of each visit should state the nature of the inspection made and its results.

Observations should be made especially in relation to the load and play of the safety valves, the play of the float, the condition of the fusible plates, of the stamps, and of the gauges, the condition of the gauge cocks, or of the tubes for showing the level of the water, the state of the flues and of the furnace; also in relation to the degree of regularity with which the heat is applied, and the feeding of the boiler kept up; in relation to the due strength of the boiler and boiler tubes, and their state with respect to interior cleanliness, &c., to the leakage of the boiler; its influence on the working of the engine, to the regularity of the play of the engine, to the more or less favourable location of the boiler in reference to the boat, and to the degree of exactness with which the local regulations imposed by the permit of navigation are executed.

When the committee of superintendence have reason to suppose that any low pressure boiler with plane ends is not of sufficient strength, they should require the proper alteration to be made in presence of the Prefect.

If the suspected boiler be of such a form that it can be proved by the hydraulic press, the committee must order a proof by that machine, and be present during the trial. The pressure employed for this proof must be equal to that to which the boiler was subjected at the time of its being stamped.

In this case, as in that of the original trial, the proprietor of the boat is bound to furnish the press and the manual assistance required. There is no objection to the proprietor of the boat furnishing, instead of the ordinary trial press, a forcing pump, such as the feeding pump of his engine, provided it be easy to use, and sufficiently powerful. It is hardly necessary to add that the proof ought to be repeated every time that it is judged necessary for the perfect security of the boat.

Finally, besides their opinion upon the proper measures in relation to boilers which they suspect to be wanting in strength, the committees of superintendence should add to the report of each visit every suggestion which the exigency of the case, or the good of the service, may seem to call for. They should never lose sight of the fact that it is their duty to originate as well as to execute.

(Signed,) Baron Capelle,
Minister of Public Works.

Paris, 27 *May*, 1830.

New table of the elastic force of steam, and the corresponding temperatures; deduced from *experiment*, from one to twenty-four atmospheres, and *calculated* for the remainder.

Elastic force of steam, taking the pressure of the atmosphere as unity.	Height of the column of mercury at 32° Fah. corresponding to the elastic force of the steam.	Corresponding temperature expressed in degrees of Fahrenheit's thermometer.	Pressure exerted of the steam on a square inch of surface of the boiler or safety valve.
Atmospheres.	Inches.	Degrees.	Pounds.
1	30	212.0	15
1½	45	234.0	22.5
2	60	250.5	30
2½	75	263.8	37.5
3	90	275.2	45
3½	105	285.1	52.5
4	120	293.7	60
4½	135	300.3	67.5
5	150	307.5	75
5½	165	314.2	82.5
6	180	320.4	90
6½	195	326.3	97.5
7	210	331.7	105
7½	225	336.9	112.5
8	240	341.8	120
9	270	350.8	135
10	300	358.9	150
11	330	366.9	165
12	360	374.0	180
13	390	380.7	195
14	420	386.9	210
15	450	392.9	225
16	480	398.5	240
17	510	403.8	255
18	540	408.9	270
19	570	413.8	285
20	600	418.5	300
21	630	423.0	315
22	660	427.3	330
23	690	431.4	345
24	720	435.6	360
25	750	439.3	375
30	900	457.2	450
35	1050	472.7	525
40	1200	486.6	600
45	1350	499.1	675
50	1500	510.6	750

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* The temperatures corresponding to 4½, 5, 8, 11, 19 and 45 atmospheres are given erroneously in the table which was copied into this journal (p. 137, vol. vi.) from an English periodical. TRANS.

On Indelible Inks for Writing on Paper.

The Committee having examined the different kinds of liquid indelible inks, are of opinion that they cannot safely be used; that the solid parts tend to separate from the liquids, and that thus time destroys the ink before use: to this defect purchasers must always be exposed. They are of opinion that solid inks offer great advantages. They consider India ink to rank first among them. The peculiar composition of this ink is not entirely known; but as imported it is a common and cheap article, so uniformly good in its quality, that, all circumstances considered, it cannot be made from a private receipt, but must be made according to one commonly known. This ink has one defect, that of not sinking into well sized paper; its good qualities are, indestructibility by age, and by chemical reagents.

The European imitation of India ink is made from lamp black, glue, and gum. Although inferior to the genuine ink, its characters are similar to those of the imported article. The ink used by the ancients was of this sort. These inks penetrate paper less readily than the India ink.

The Committee offer the following receipts for indelible writing inks:

First Receipt.—Dilute muriatic acid until it has the specific gravity of 1.01 ($1\frac{1}{2}°$ Baumé.) Use this liquid instead of water in mixing India ink.

The ink runs more readily when diluted acid is used than when water alone is employed. It is flowing, and penetrates the paper.

Second Receipt.—To a solution of acetate of manganese of the specific gravity of 1.07 (10° Baumé,) add one ninth of its bulk of acetic acid (vinegar,) of such a strength that 100 parts will saturate 160 parts of crystallized carbonate of soda. Use this liquid to rub India ink. To render this ink indelible, expose the writing to the action of ammoniacal gas, by holding it over a solution of ammonia. This ink has the advantage over the first of not exposing the paper to acid reaction, the method of using it is, however, not so simple. [Report of a Committee* of the Academy of Sciences of Paris.]

[*Ann. de Chim. and Phys. Sept.*, 1831.

On the use of particular kinds of Paper, for preventing the removal of Writing, &c.

Colouring matters which, placed upon paper, would prevent the removal of ink, must be changed by all reagents which would destroy common ink. Such matters are usually destroyed by air and light, and may be affected by substances accidentally brought in contact with them.

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* Gay Lussac, Dulong, Chaptal, Deyeux, Thenard, D'Arcet, Chevreul, and Serullas.

Notwithstanding such objections, paper of this kind may be useful. For example, the paper proposed by M. Contin, may be of great use in ordinary business transactions, particularly that covered with delicate and regular designs; even the tinted paper proposed for larger documents may be used with advantage.

We should in all cases prefer the use of an indelible ink.

[*Ibid.*

Sulphate of Copper in Bread.

In examining the subject of the use of sulphate of copper in preparing bread, M. Sarzeau has endeavoured to ascertain some method by which the copper always found in grain, may be distinguished from that in the sulphate of copper, which may be used in preparing bread, and also what proportion of the latter salt renders bread *poisonous*. The results of his experiments, those relating to the noxious qualities having been made upon himself, are as follow:

1. Whenever the ashes of bread give copper by the action of the blow-pipe, copper has been used in making the bread.
2. When the liquid resulting from mixture of the ashes of the bread with water, gives a red shade to the ferrocyanate of potassa, the bread has noxious qualities.
3. If the sulphate of copper used is $\frac{1}{5625}$th part, by weight, of the flour used in making the bread, the poisonous qualities will be decidedly felt. [*Journal de Pharmacie for April*, 1832.

B.

Original experiments on the Adhesion of Valves, or Disks, operated on by Diverging Streams of Compressed Air. By Mr. T. Hopkins.

From the Transactions of the Literary and Philosophical Society of Manchester.

On the 11th of October, 1824, Mr. Roberts affixed a valve to the aperture of a pipe, used as a waste pipe, for the purpose of regulating or equalizing the force of a blast of air which was blowing a furnace. To his surprise, however, he found that the valve, instead of being readily blown off by a strong blast, remained at a small distance from the aperture of the pipe, and was removed to a greater distance only by a considerable exertion of the power of the hand. This singular phenomenon was witnessed by many gentlemen, members of this society, in the same week, and appeared to be viewed by them all as equally new and extraordinary.*

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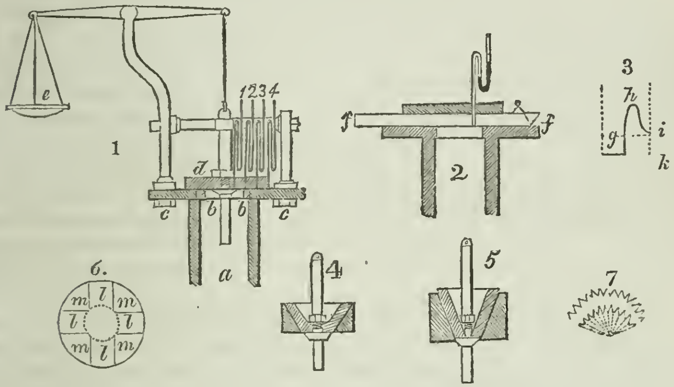
* It is said that Mons. Clement, of Paris, was in Manchester at this period, and that he saw the air valve adhere to the pipe, yet he afterwards, it appears, represented the discovery to have been made in France long subsequent to the time at which he saw it at Mr. Roberts' works.

Mr. Roberts made some experiments on his air valve at the time, and various theories were then suggested to account for the adherence of the valve to the pipe. It was not, however, until the month of September in the present year, that I agreed to join him in making further experiments, a part of which I now proceed to give.

A vertical section of part of the apparatus used is given in fig. 1, where *a* is a pipe, three inches diameter, with the aperture contracted to $2\frac{3}{8}$ diameter, at *b*, *b*, and surrounded by a flanch *c*, *c*, $10\frac{3}{4}$ diameter, to form a seat for a valve. On this seat was placed a circular disk or valve *d*, six inches diameter, with a pin in its centre, by means of which it was left at liberty to rise or fall freely, and kept at the same time perpendicular to the aperture.



The valve was attached to one end of a scale beam by a string, and balanced by weights placed in a scale *e*, attached to the opposite end of the beam. The valve being thus placed on the seat without any weight of its own to press downward, the stream of compressed air was admitted into the pipe *a*, when the valve *d* rose from the flange or seat *c*, 1-32nd of an inch, and there remained stationary. Thirteen ounces, avoirdupois weight, were now put into the scale *e*, which raised the valve to 1-12th of an inch above the seat. Twenty-six ounces raised it to 1-8th of an inch, and thirty-two ounces raised it to 1-4th of an inch, but any weight beyond this last caused the valve to fly abruptly off.

It thus appeared, that when the valve was raised from its seat a quarter of an inch, there was the greatest difference between the force of the issuing current of air pressing against the *under* side of the valve, and of atmospheric pressure on the *upper* side of the valve. The pressure of the atmosphere was greater than the force of the issuing stream of previously compressed air, a weight of thirty-two ounces being requisite to establish an equilibrium.

That we might ascertain what was the state of the stream of air under the valve, in different parts of it, four double syphon tubes were procured, and proper quantities of mercury being put into them, they were inserted in holes made through the valve at certain distances from each other, as shown in fig. 1 at 1, 2, 3, 4. The inserted limbs of these tubes being thus left exposed to the action of the stream of air, the compressed air was again admitted into the pipe *a*, and the valve rose as before, 1-32nd of an inch.

The tube 1, in that part of the valve *d*, which was over the aperture *b*, had the mercury in it 1½ inches higher in the *outer* than in the inner limb, and consequently showed a pressure from the compressed air below it, above atmospheric pressure, equal to 1½ inches of mercury. The tube 2, which was near to the aperture *b*, but over the inner edge of the seat *c*, showed a rise of the mercury of 3-10ths of an inch in the *inner* limb of the tube, and consequently a pressure from the air below it *less* than atmospheric pressure by 3-10th of an inch,—or a partial vacuum of 3-10ths of an inch of mercury. The tube 3, at the same time showed a similar vacuum of 1-8th of an inch of mercury. The mercury in the tube 4 was undisturbed.

The valve with the four tubes in it was now raised above its seat from 1-32nd of an inch, until it was 1½ inches above the seat, by gradations of 1-32nd of an inch each, and the heights of the mercury in the tube were noted at each step, distinguishing by a *p* or a *v*, whether they showed pressure from below, or a partial vacuum, and thus a table of five columns was formed. The first column showed the height of the valve above the seat, and the other four columns the heights of the mercury in the four tubes, and whether they indicated pressure or vacuum.

This table showed that the pressure from the stream below, on tube 1, continued at 1½ inches of mercury, until the valve was raised from its seat to 1-16th of an inch above it; but from that elevation until it was raised to 1½ inches from the seat, the mercury showed a gradually diminishing pressure, and at that height the pressure was only 6-10ths of an inch.

Tube 2 showed its greatest degree of *vacuum* which was one and 8-10ths inches of mercury, when the valve was raised 3-32nds of an inch; from which point, as the valve was further elevated, the vacuum became less, until at a height of 3-8ths there was no vacuum,—the mercury in the two limbs of the tube being at the same level. On raising the valve from 3-8ths to 1½ inches, this tube showed an increasing *pressure* from the stream of air below, and at the least named height the pressure was 4-10ths of an inch of mercury.

The tube 3, showed its greatest degree of vacuum to be 7-20ths of an inch of mercury, and it was when the valve was up 11-32nds of an inch. As the valve was raised higher, the vacuum became less, until at the height of 1½ inches it was nothing.

In tube 4, the mercury began to show a small degree of vacuum when the valve was raised 3-32nds of an inch; when it was up half an inch the vacuum was one-fourth of an inch, being its greatest degree; from this point the vacuum diminished, and when the valve was 1½ inches high, there was very little difference in the levels of the mercury in the two limbs.

A similar course of experiments was gone through with a valve eight inches diameter, with some small variations in the results, which were noted in another table; but the only one worth mentioning is, that while the six inch valve required a little more than thirty-two ounces in the scale *e*, to detach it from its seat, the eight inch valve required forty-eight ounces.

From a general view of the results thus obtained, it appeared that while the valve adhered to the seat, and remained at but a small distance from it, a circular stripe or flat ring of attenuated air was found between the valve and its seat, and near to the aperture *b*, the air at the same time in the parts further from the aperture becoming more dense, until close to the periphery it became nearly of atmospheric density; but as the valve was raised, the ring of the attenuated air approached the outer part or periphery of the valve.

To find the form and nature of this ring, it now appeared desirable that the different heights of mercury in the same tube, indicating degrees of vacuum should be ascertained at small and equal distances, beginning at the edge of the aperture, and proceeding along a radial line to the periphery of the valve. To accomplish this, a moveable slide was dovetailed into the valve, and in this slide was inserted the lower limb of one of the double syphon tubes with mercury in it as before, shown at fig. 2, where the tube is placed over the aperture, and indicates a pressure from the compressed air of 1½ inches of mercury.

This valve being placed on the seat, the slide *f*, *f*, was moved until the tube came over the seat, and the distance of the tube from the edge of the aperture was noted when the mercury first indicated a slight degree of vacuum. From this point the slide, and consequently the tube, was drawn outward 1-32nd of an inch, and the height of the mercury indicating vacuum again noted. In this way, by stages of 1-32nd of an inch each, the tube was drawn to the outer edge or periphery of the valve, and at the height of the mercury noted at each stage. The different heights of the mercury in all these stages, with the exact places of the tube at the times, were then marked by dots on paper, and these dots being connected by lines, we obtained the curve represented in fig. 3. In this diagram *g* shows the point at which the vacuum was first indicated, and the line from *g* to *h*, represents the increase of the degree of vacuum, until at *h*, it is 1¾ inches of mercury. From this point the reduction of the degree of vacuum is seen by the curve from *h* to *i*. The straight line *k*, a little lower down, represents the pressure which the mercury showed when the tube was over the aperture.

The valve was now raised higher from its seat, and the tube moved as before, and data obtained for the formation of other curves. When the valve was 3-16ths above the seat, the tube being placed over the aperture, showed a pressure of only one and four-tenths of an inch of mercury; but the tube being brought over the seat at a distance of 5-32nds from the edge of the aperture, showed a vacuum of one and eight-tenths of an inch of mercury. From that point proceeding outward, the vacuum became less.

These experiments showed, that until the valve was raised to a certain height above its seat, the under side of that part of the valve which was over the aperture, was exposed to a pressure of 1½ inches of mercury more than atmospheric pressure; and the under side of all the rest of the valve, forming an outer stripe or ring, was exposto a pressure less than atmospheric, or had a partial vacuum varying from one and eight-tenths of an inch of mercury up to atmospheric pressure. The superior pressure against the under side of the centre of the valve, must then have been counterbalanced by the inferior pressure against the under side of that portion of the valve which is nearer to the periphery,—and more than counterbalanced, for atmospheric pressure on the top of the valve was still so superior as to admit of a weight of thirty-two ounces being applied, before that pressure could be overcome and the valve raised.

Valves of various smaller sizes were now tried, and it was found that one of four and one-fourth inches diameter, was what may be called the neutral size over an aperture of two and three-eighths diameter; as, when it was balanced it would just adhere to the seat when the air was admitted, but the least weight placed in the scale raised it. Valves of any size smaller than this did not adhere to the seat, and would therefore be proper valves for such a pipe.

A conical valve was now procured, the greatest diameter of which was six inches on the upper side, and its least diameter was two and three-eighths inches, the same as the aperture, and its thickness one and a half inches. This valve being fitted into a proper seat, required as many ounces fitted to raise it from its seat as the flat six inch valve did. See fig. 4.

Another conical valve, whose greatest diameter was the same as the flat neutral valve, four and a half inches, its least diameter two and three-eighths, and its thickness three inches, was fitted like the preceding one, into a seat of equal thickness with itself. This valve, however, if less than six ounces in weight, was blown off by the blast. And thus it appeared, that a conical valve, may be less disposed to adhere to the seat than a flat valve, the diameter of the upper sides of both being the same. See fig. 5.

A phenomenon, singular in appearance, was exhibited while using these conical valves. It became necessary to fasten a seat with a hollow cone to the flanch, and, in the experiments, the issuing stream of air was made to pass between the cone and its seat. But when this seat was liberated from the flanch, and the stream of air suffered to flow, one stream rushed between the cone and the seat, and another between the seat and the flanch. And thus the seat of the cone was held in its situation by the two streams of air, without being in contact with any thing else.

During the experiments burning paper was placed on the valves, that the flame and smoke might show whether there was any atmospheric current rushing down upon it. But it was only at the periphery that the flame was drawn down, until it came in contact with the stream of air issuing from under the valve, which cut off the flame as abruptly as it could have been cut through with a knife, apparently from its force and coldness. On the valve the flame blazed in the way in which it ordinarily does, when there is no current of air acting upon it.

In endeavouring to account for these phenomena, it appeared that the air in the aperture was projected or driven from the aperture as from a centre, in radial lines in every direction through enlarging circles, and thus became attenuated as it was thrown off from the centre, in the way that light is diminished according to its distance from its radiating point. For the purpose of ascertaining whether this was a correct view, or not, another experiment was made.

Instead of a circular valve, one of the form of a cross was used, six inches in diameter, of which fig. 6 is a plan. The centre of this cross valve just covered the aperture *b* in fig. 1, and the four arms *l*, *l*, *l*, *l*, extended to the diameter of six inches. The four angular spaces between them left on the seat of the valve were covered with pieces of wood *m*, *m*, *m*, *m*, fitted to the spaces and fastened to the valve seat, leaving the cross valve at liberty to be raised between them. By this contrivance the compressed air, on issuing from the aperture, was confined to four separate streams of equal and uniform breadth, which could not diverge, but passed under the cross until they escaped at the ends of its arms. The tubes with mercury, as in fig. 1, having been inserted in the arms showed not more than one-eighth of an inch vacuum in any part of the arms, and less towards their outer extremities; and this small vacuum probably was the result of some air making its way under the angular pieces *m*.

The cross was now raised enough to leave considerable spaces for the stream to expand from its previously compressed state, and to become rarified, but no greater attenuation was indicated by the mercury. And thus it appeared, that when there was but little space, only 1-32nd of an inch, under the circular valve for the air to be projected into, there was an attenuation, or partial vacuum of $1\frac{3}{4}$ inches of mercury, but when the cross valve was gradually raised from 1-32nd to the height of half an inch from the seat, and when of course there was ample room for expansion, not more than 1-8th of an inch vacuum was indicated.

From these various phenomena it appeared that the vacuum under the circular valve was produced by the spreading of the air from a smaller to a larger circle, immediately after it left the aperture. For on the air being prevented from spreading by the pieces of wood *m*, fig. 6, when fastened to the seat of the valve, the vacuum nearly disappeared in the streams under the arms of the cross valve; but by attaching the angular pieces to the cross valve, and suffering both to rise together, the full vacuum of $1\frac{3}{4}$ reappeared as with the circular valve.

When the circular valve *d*, in fig. 1, is placed on the seat, there is stagnant atmospheric air within the aperture *b*. On the condensed air being admitted into the pipe *a*, the stagnant air is put into motion, and before it can overcome the inertia of the valve, is forced between the outer parts of the valve and its seat. The air, while being thus forced is, however, compelled to diverge from a circle, whose diameter is two and three-eighths to one of a larger diameter, and is consequently dilated and attenuated.' The impulse given by the compressed air on its first admission to the stagnant air in the pipe, causes the stagnant air to commence the process, but the compressed air follows instantaneously, and through the force with which it is impelled by the original moving power, is projected under the valve, and there forced to diverge with a velocity proportioned to the amount of the projectile force.

The projectile force acting through the stream of compressed air, and the peculiarly shaped and confined space through which the air is driven, are then the causes of its dilatation, until its degree of rarity is beyond that of the atmosphere, when atmospheric pressure on the upper side of the valve preponderates.

This view will, perhaps, be illustrated by supposing the compressed air at the edge of the aperture, to be an elastic ring of two 3-8ths diameter, and that every part of this ring shall be struck with equal force from the centre, in a radiating direction to the circumference: by the time that the ring is projected to a sufficient distance to be a diameter of, say four inches, it will be stretched from a smaller to a larger circumference, and every part of the ring will be equally stretched or attenuated. A part of such a ring may be supposed to be represented in fig. 7. It is not, however, necessary that the substance projected should be elastic, for if the ring were made of lead, the effect would be the same; or if grains of sand, or small lead shot, could, in like manner, be thrown from a centre, in all directions around, it is clear that as they were removed farther from the centre, the grains or shot would be more distant from each other, or the stream of them would be more attenuated.

By a reference to the curve fig. 3, representing the degrees of vacuum, it will be seen that the circle of greatest vacuum is near to the aperture; and it may be inferred, that this fact is opposed to the theory of forced divergence, as on that theory it may be thought that we ought to have the greatest vacuum where the divergence was the greatest, and consequently near to the periphery of the valve. But it should be borne in mind, that the issuing stream of air has to overcome atmospheric resistance; and when, by diverging, it has become rarer than the atmosphere against which it is acting, the momentum requisite to keep it so is soon expended, and the stream under the outer parts of the valve not having sufficient force to overcome atmospheric resistance from without, yields to it, and is brought to common atmospheric density. If the velocities of the stream under the different parts of the valve could have been ascertained by stages of thirty-secondth parts of an inch, in the same way that the degrees of vacuum were found by the heights of the mercury, it is presumed that this point would have been established by experiment, instead of being left dependent on an inference.

The moving of the circle of greatest vacuum outwards, as the valve was elevated, does, however, exhibit evidence of the justness of the inference. When the valve was but little raised, the force of the stream was expended in diverging a part of itself, near to the aperture, but when the valve was considerably raised, the superior density of the stream was not confined to that part immediately over the aperture, but showed itself also between the valve and a part of its seat. When it was raised half an inch, the same point *h*, which in fig. 5, shows the greatest vacuum, indicated a pressure of a quarter of an inch of mercury, while the circle of greatest vacuum, had removed farther from the aperture.

It has been suggested, that the formation of the vacuum may be accounted for from the known tendency of a compressed spring when liberated, to fly beyond the point at which it will finally settle. But this action of a spring is only one instance of the operation of a general law of nature which is applicable to all bodies. When any body, elastic or non elastic, is put in motion, its inertia causes it to continue in motion in the direction in which it has been impelled until its force is expended. The force of a liberated metallic spring is expended in the effort to overcome the tenacity of the substance of which it is composed, while the force of a cannon ball, fired into an earthen bank, is expended on the resistance presented by the earth; but it is projectile force that is expended in both instances.

In a short time after the phenomenon of the adherence of the air valve was observed by Mr. Roberts, he ascertained, by experiment, without knowing that it had been done before, that *water*, when forced through a conical pipe, with considerable velocity, will draw out other water, placed below in an open vessel, if one end of a small tube is inserted in the conical pipe, and the other end is immersed in the water, in the vessel below: thus showing that water, an inelastic fluid, produced the same effect that air did, when rushing out in a stream, confined in a peculiar manner. And at the time this paper was going to press, water was, by pressure from a column of considerable height, made to issue from a pipe with a valve placed over it, similar to what is exhibited in fig. 1, when the valve, instead of being forced off by the issuing stream of water, was found to adhere to the seat, at a small distance from it. And when the apparatus was inverted, and the valve consequently placed below the seat, upon the water being permitted to flow, the valve, instead of obeying the law of gravity and falling by its own weight, or of being driven off the force of the stream of water, adhered, with considerable firmness, to the seat.

¶ ON WORKING IRON AND STEEL.

[Continued from p. 123.]

On Steel.

Steel is made by combining carbon with iron: it is done by immersing the iron in carbonaceous matter at a white heat and excluded from air, till it has imbibed enough all through. It is made to receive more or less, according to its intended use. Pure iron is not altered nor increased in hardness by sudden cooling from a red heat; but the small quantity of carbon which is combined with it to form steel, greatly increases its strength and toughness, leaving it both malleable and ductile, and gives it that peculiarly valuable property of becoming extremely hard, if suddenly cooled from a red heat by immersion in water or by any other means. With this first dose of carbon it is called *mild steel*, because it possesses all the valuable properties of iron, with increased strength.

A larger quantity of carbon increases the hardness of the metal, and makes it more brittle when hardened by sudden cooling, and also renders it fusible; therefore it is called *cast steel*, and being less malleable, it is more difficult to work.

When steel is made without fusion, by immersing it in carbon, the process is called *cementation;* and it is called *blistered steel*, because, while the carbon is entering, it meets with oxygen, or hydrogen, or other impurities, which it causes to become gas or vapour, and this blisters the steel. There is a considerable quantity of steel brought to market with defects which appear to be the remains either of these blisters or of the weldings that follow.

Cast steel, being made by fusion, admits of an equal distribution of carbon, and of the escape of every particle of gas, vapour, or any other substance not compatible with it at so great a heat, leaving only such as can combine with it; therefore it is the only steel we can be sure of obtaining quite sound.

The question whether steel contains any thing besides carbon and iron, is chemical. A good workman only requires metal perfectly free from flaws, and quite homogeneous, and that will harden at the lowest heat; for this last test supersedes all others in proving the goodness of steel and its fitness for the best purposes.

The soundness of cast steel renders it most desirable to use; but the excess of carbon makes it too harsh, and therefore more difficult to work; but by frequent heatings and hammerings it may be reduced to the state of mild steel, the excess of carbon burning out while forging, and then it must be the best steel for general use. Yet shear steel predominates in the market, and more particularly in the various manufactured tools, probably from being cheaper. Therefore it is desirable to discover its faults, the better to cure them.

Perfectly pure iron cemented in pure carbon would probably make steel without blisters; but as in practice blisters are produced, there must still be oxygen in the iron, or some other substance that is turned into gas or vapour by the addition of carbon. Now, the blisters are mostly on the outside, but why not equally throughout? The answer is, the strength of the metal resists the assumption of the gaseous or vaporous state. Is not, then, the blistered outside purer or better steel than the centre? for though the carbon penetrates to the very centre, is it not obliged to combine with the oxide of iron and other impurities in the solid state, and remain so, the strength of the metal forbidding the change by which it would have a chance of escape? Again, if permanent gas is formed in any of the small blisters within, how is it to escape? the hammer may greatly reduce the size of such blisters; but will there not be small flaws or cavities remaining? If, in addition to this, the iron contains the bases of the earths or alkalies, or the earths themselves, these latter may be reduced by the joint action of the carbon and iron, and then being vaporised by the heat, the metal may be blown into blisters. In this case the cavities would probably be coated and thus rendered unweldable; these flaws would then spread with the metal while working into plates or rods, and the mass, though close, would not be united.

The blistered steel must be unequally carbonised, the outside containing most; it is fitted for the market by drawing out to greater lengths by the hammer, then folding double, and welding together again; then drawing out, and again welding several times. This mixes the various parts together, and thereby distributes the carbon more equally, and condenses the metal; it is then called *shear steel*, and considered fit for use. Now, these weldings are liable to introduce flaws,—first, by imperfect union; secondly, by the carbon burning out of the surfaces that meet together, giving a stratum either of iron or of steel with less carbon; and these being softest, would give way during the extension of the steel.

Now, whether from original blisters, or similar cavities from imperfect welding, such defects do very largely accompany this steel; and it is a question, whether any process short of fusion can totally remove them. Yet long continued forging greatly improves the soundness and homogeneity.

Besides flaws, there is another defect often met with in steel, it is said to have pins; for, when filing or turning, it appears to have knots or pins in it harder than the rest of the metal. A similar defect occurs in brass, when, through the negligence of the founder, it contains iron or steel filings; also in wood with hard knots: but this evil is worst of all when it occurs in steel, which naturally is hard to work. I have met with it in all degrees, from mere harshness up to real hardness; so that while turning in the lathe, these parts would remain projecting out, and damage the tool rather than be cut away. I have filed some off, and then found their hardness nearly approach that of the file. This inequality of hardness causes the work and tool, though held by the rest, to spring away from each other, rendering it difficult to turn true. I think it is often caused by portions of the metal being over-steeled, *i. e.* so completely charged with carbon as not to soften by slow cooling. Another cause is stated by Mr. Clement, who broke the steel across these pins, having filed away the back to render it weak enough to part at the right place, when he found a cut or division, on which account he attributes the flaw and its hardness to oxide of iron, which prevented the parts from welding together; and as oxide of iron is known to be harder than steel, by its being used for polishing that substance, it most likely will cause hardness where it occurs. It would be desirable to ascertain the state of the surface of the deepest blisters, to know whether they are alloyed or oxidised, or in any way differing in their state of carbonization from the most solid parts. When such spots occur from oxygen, the adjoining parts must be iron; for there will be a gradation from oxide through iron to the steel, therefore the circumference of such a spot would be softest.

An excess of carbon renders steel harder and more brittle, therefore inequality is liable to occur. This is illustrated by iron hardened while casting; and of that which is intended to be soft, portions are frequently found hardened by the wet sand: these parts near the outside break with a more glassy fracture than hard steel. Good steel, hardened by plunging from a red heat in cold water, will always become soft by slow cooling from such a heat; but this hard cast iron does not: it requires burning several hours at a red heat, and must not be smothered by fuel to prevent decarbonizing, but, on the contrary, should be exposed to the current of air, that some portion of the carbon may burn out while the remainder has a tendency to equalize itself; then, if slowly cooled, it is found soft. Now, the knots or pins in steel are not softened by slow cooling, and to burn them out would spoil the steel, it having no carbon to spare but in the pins (supposing this to be the cause of their hardness); and keeping it hot in close vessels will not produce equality sufficient for any good purpose. Even cast steel is liable to long veins of harder portions than the rest. All these defects show the need of farther attention to the improvement of steel, and for this purpose two sorts of hammering are requisite.

The first should be at a forging heat, to knead the parts, and keep them moving among themselves almost like a paste; and should be continued till the different qualities are not only intimately mixed, but, if I may use the expression, really dissolved in each other, producing perfect homogeneity; for the carbon being thus spread, will discover every particle of oxygen, and (it is supposed) will expel it, and the metal will be rendered as sound as we can expect from cemented steel; for if free from oxygen and all alloys, except the carbon, there is nothing to prevent a perfect union of all the parts while under the hammer. Good steel consists of that proportion of carbon and iron which forms the strongest and toughest compound; each best portion, therefore, when brought into contact by the hammer, remains so, and resists its force the more from the greater cohesion of its particles; hence the redundant or deficient portions suffer most kneading, till they are all equalized, and the cruder impurities are either beaten out, or formed also into a homogeneal compound with the whole mass.

Having thus far obtained sound steel, it is yet by no means in a good state, being very unequal in density, and in a state of distraction—some parts close and dense, others squeezed out, and some nearly rent asunder; therefore a second hammering is necessary at a particular heat, and under circumstances as similar as possible to those described in the former part of this paper; such as recesses in the anvil, or in blocks laid thereon, suited to the shape of the steel.

For this purpose the metal is first brought as near as eligible to the size in which it will be used, and then is to be hammered in order to close and condense the metal equally and to the utmost all through, and yet leave every part in a state of rest and ease—a condition extremely essential for good springs, sword blades, musical wire, and every thing that has to vibrate, or act by its tension; for if one part is denser than another, or more at ease, the weaker parts will have most, if not all of the play, and will soon break. And that this is not so often noticed to be the cause as it should be, is shown by the crudeness of the cure. If a spring breaks, it is frequently replaced by what is called a stronger, that is, a heavier one, losing a portion of the play, and what remains being still upon the weakest parts; so that though it may last longer, yet it ultimately breaks. This may also account for the breaking of axletrees that have appeared sound; for they are subject to such violent shocks as to require every part to yield equably; for the axiom, that the strength of the whole is only that of the weakest part, rendered less so by the weight and stiffness of the stronger parts, is as truly applicable to springs as to ships.

This second hammering is also to prepare the steel for receiving the utmost hardness, by that peculiar property which it alone possesses—namely, that of receiving a brittle hardness when suddenly cooled from a red heat; but though this hardened steel is brittle, its toughness greatly exceeds that of any other brittle substance.

It is this quality that makes it completely the *master metal*, the one by which we give shape and form to all the others, and fit almost every thing for our use. I must here observe, that this hardness cannot be given in part, it must always be given in full; and so true is this, that in a piece of steel, part of which is hard and part soft, no gradation of hardness can be detected; the soft parts adjacent to the hard ones being quite as soft as any others; indeed, so much so, that they have been thought by some to be softer than if slowly cooled. This appearance may be accounted for in the following way: Suppose a rod of well hammered steel is heated at one end for hardening, there will be a gradation of temperature from the coldest to the hottest end, and the annealing, or reduction of that hardness which it has received from the hammer, will be in proportion to the heat, consequently the rod will be softer and softer towards that end where the heat is applied. On plunging the bar into cold water, that portion which had become hot enough to harden becomes quite hard, and close adjacent to it will be found that part which having been the most annealed, will bear twisting and bending more than any other. But though this hardness must always be given in full, it can be let down in any assignable degree; that is, a portion of its brittleness may be removed by a moderate heat, and a greater portion by more heat, and so on, as the purposes may require. This is called *tempering;* and if hard steel be brought to a red heat and suffered slowly to cool, it becomes as soft as if never hardened; it is then ready for re-working or re-hardening. This is called *softening*, and is distinguished from *annealing*, which is the same process of slow cooling but applied to steel, iron, or brass, merely to remove all mechanical condensation, whether by hammering, flatting, wire-drawing, bending, or any other work; for if metal has been altered in shape by the hammer or other work as much as it will bear without breaking, then by annealing, it will be softened, and may again be bent or altered as much more; and so on, as often as requisite. Now, as different degrees of heat remove different degrees of condensation received from the hammer, and a white heat removes all, it is of great consequence to harden from the lowest possible heat, in order to retain as much condensation as may be; and it is a fortunate coincidence, that the greater the condensation, the lower is the heat from which steel will harden, and the stronger and tougher will it be. But should this condensed metal be once over-heated, it will no longer harden from that lower degree, but only from a heat near that to which it has been raised; its condensation, with the advantages dependent on that quality, can only be restored by re-hammering. The lowest heat at which steel is generally brought to harden is a dull red, just visible in daylight. Therefore, to be safe, a dull red, only visible in the dark, is chosen for the hammering. At this heat also it can be kept coated with carbonaceous matter, instead of having any burnt out, which is of particular consequence. For this purpose a smith's forge, in rather a darkish place, having its flat bed even with and near the anvil, is kept smothered with small fuel, the bellows being used only enough to keep the fire alive, so that the gas or smoke cannot burst into flame. The several pieces of steel are laid a little in the half-kindled fuel, enveloped in smoke; this coats them with carbonaceous matter, which the hammering heat can hardly dispel. They are brought in succession from the fire to the hammer, and back again to the fire when too cool; the hammer moves quick, and every part of the steel in close succession is slowly passed under it, and then (the position being changed a few degrees) it is again passed under, and so on, till it has been hammered in every direction, being often reheated ; and this is continued as long as the workman thinks it can be of service. Experience teaches him to know by the feel, the sound of the blows, and the lessening degree of impression, when the steel is hammered enough. By such means, and an honest zeal for the goodness of his work, Mr. Walby, whom the society in the year 1804 rewarded for his hammer, produced the best trowels that probably were ever made; their toughness, spring, and elasticity, seemed carried to the utmost. At this heat the metal spreads much less; but yet, unless confined within a recess so as entirely to prevent spreading, the outer band will be so bad as to require cutting off, it will be so stretched and rent by the pressure of the inner portion.

[TO BE CONTINUED.]

On the utility of fixing Lightning Conductors in Ships. *By* W. S. Harris, *Esq. Member of the Plymouth Institution.*

1. A Thunder-storm is the result of a great natural action subsisting between an extensive stratum of cloud, and a corresponding portion of the earth's surface, together with the intervening atmosphere; and is the result of some powerful agency, the nature of which is as yet undiscovered.

2. The active principle of a thunder-storm, however, may be considered as an extremely subtle species of matter, universally perva-

ding nature, and distributed in bodies, in quantities proportionate to their capacities for it, so that when accumulated in and about certain bodies, and abstracted at the same time from other bodies, a tendency to regain the previous state of proportionate distribution is marked by a certain train of phenomena; thus, a concentrated action is frequently set up between the overcharged and undercharged bodies, which produces all the effects of a violent and terrific expansive force, for the original state of proportionate distribution is often restored by a rapid explosion, at which instant the most compact bodies are broken; whilst, at the same time, there is such an evolution of heat, that substances directly in the line of action are sometimes inflamed, fused, and ignited.

3. This easy and elementary view of electrical action may not be altogether useless; for to investigate any branch of physical science with success, it is always advantageous to arrange our ideas in some determinate order, by means of which the details assume a clear and connected form; for although it must be admitted, that every theory is merely a way of picturing to ourselves the course of nature, it may be always sufficient, and admissible, so long as it is consistent with the observed phenomena, and not contradicted by any known fact.

4. In the progress of electrical inquiries, it has been found, that some substances oppose but comparatively little resistance to the passage of the electrical agency, whilst, on the contrary, other substances seem to arrest its course altogether; a fact which induced electricians to consider bodies as possessed of these peculiar properties, and to classify them in relation to this *conducting* or *non-conducting* power. Substances which oppose but comparatively little resistance to an electrical explosion, have therefore been termed *conductors,* whilst those which offer resistance to its progress, have been termed *non-conductors*, or occasionally, from the same cause, *insulators.* In the conducting class, we find all the metals, concentrated acids, water, well-burnt charcoal, wood, diluted acids, and saline fluids, most earths and stones, flame, smoke and steam. If any of these substances resting on the ground, be put into contact with an electrical machine, whilst a current of sparks is passing from it, the sparks will immediately cease; in consequence of the electric matter being transmitted by them to the earth—an easy and striking experiment. Non-conductors of electricity, or insulators, are all vitreous and resinous substances;—dry, permanently elastic fluids, such as air, baked wood, silk, pure carbon, and most precious stones, oils, dry vegetable substances, as also, dry marble, chalk, and lime, wool, hair, feathers, dry paper, parchment, and leather. If, whilst a current of sparks is passing from the electrical machine, any of these bodies be put into contact with it, and rest as in the former instance on the earth, little or no difference will be perceived, the sparks will continue.

5. Although for general purposes, the various bodies in nature may be considered as belonging to one or the other of these classes, a gradation of effect is observable from one class to the other; so that the conducting or insulating power of some substances, compared

with that of others, may be considered as imperfect: hence has arisen a third class, which consists of the remote* extremes of the other two, and which may be considered, in the power of arresting or transmitting certain electrical actions, as appertaining to either. Thus wood, hemp, stone, and the like, may become insulators to a state of low electrical action, and conductors to a high one.

6. The manner in which accumulations of atmospheric electricity proceed, may be referred to the following principle: When two substances of the conducting class are directly opposed to each other, and are separated by a substance of the non-conducting or *insulating* class, leaving the one free and the other insulated, the proportionate state of electrical distribution may become deranged to the greatest possible extent. Now, in nature, the conditions of such an experiment are found in the relative situations of the sea and clouds, and intervening air; so that when, from any cause, an evolution of natural electricity takes place, and heavy masses of vapour are present in the atmosphere, we have immediately an insulated conductor (a cloud,) directly opposed to a conductor in a free state, (the sea or land,) and an intervening non-conducting or insulating medium, the air; hence results a charged battery of enormous power: the attraction of the opposite electrical states, therefore, may become at length so powerful, that the electric matter breaks down the intervening resisting air, with a terrific and dense explosion—an effect perfectly analogous to the explosion which frequently occurs at the time of conveying a high charge to an electrical battery, and which is attended by a peculiar fracture of the interposed glass.†

7. The year 1752, which marks an important era in electrical science, from the celebrated discovery of the principle just mentioned, under the form of the Leyden jar, gave to the natural philosopher an easy method of concentrating large quantities of electricity produced by artificial means, so as to discharge it upon or through bodies with an instantaneous and violent explosion. From the time, therefore, that the cause of lightning became *identified* with that of ordinary electricity, and that the gigantic attempt of Dr. Franklin and other philosophers, of actually drawing down the matter of lightning from the clouds, was fully accomplished, the effects produced on bodies by these minor electrical discharges, with their mode of action, acquired a new interest; and many important experimental researches into the laws and operation of the great natural action, were successfully carried on by means of the ordinary artificial one.

8. Amongst the many important results arrived at by such inquiries, are the following:—

First, In every case of electrical explosion, there are universally two points of action, one *from* which the electric matter may be supposed to proceed, and another *towards* which it may be considered as determined.

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* Would not the term *proximate* be more appropriate than *remote*, those extremes which most nearly approach each other being manifestly intended.—Editor F. J.

† An explanation of some of the phenomena of thunder-storms on this principle will be found in my printed letter to Sir T. B. Martin, K. C. B. Comptroller of his Majesty's Navy.

Secondly, At the instant before which an explosion takes place, the stream of electricity moving to restore the equilibrium of natural disposition, seems by a wonderful influence to feel its way, and mark out as it were, in advance, the course it is about to follow; which course is *invariably determined through the line or lines of least resistance* between the points of action.

A few illustrations from experience of damage by lightning, may serve to render these facts evident.

(*a.*) The brig Belisle, of Liverpool, in November, 1811, was lying afloat, abreast of Mr. Evan's yard, at Bideford, when a vivid flash of lightning shivered her fore-top-mast and fore-mast, tore up the forecastle deck, and struck a hole through her starboard side, starting several butts in the bends, whence it passed into the sea.

(*b.*) The French ship Coquin, at anchor in the bay of Naples, was struck by lightning in the afternoon of Christmas day, 1820. The electric matter passed, in this case, close to the main hatchway, upon a spare anchor, and from thence through her bottom, a little below the water's edge on the larboard side. The boats of the squadron in Naples Bay, assisted to slip her cables and run her ashore in the mole.

(*c.*) The United States ship Amphion, Blone, master, of and thirteen days from New York, bound to Rio, was struck by lightning on the 21st of September, 1822. The lightning descended by her mizen-mast, destroyed the compasses and cabin furniture, splintered and tore to pieces the ceiling, bulk-heads, and rudder trunks, shivered two hold beams, and passed out through the quarter into the sea, tearing off part of its sheathing in its course.*

(*d.*) His Majesty's frigate Paima, commanded by Captain Worth, was struck by lightning in 1814, in the harbour of Carthagena, Spanish America. The fore-top-mast was knocked over the side, the lightning guttered or scooped its way, two inches deep, and one inch and a half wide, under the hoops of the mast, without injuring them, as far as the main deck. Here it fell upon the wet cable which had been just shortened in, and was lying against the after beam; it knocked out a piece of the beam, and passed by the wet cable out of the hawse hole, the lead of which bore evident marks of the explosion. It was perfectly calm at the time, and the lightning, besides striking the ship, *struck also down upon the sea* several times, and within a short distance of the ship.

(*e.*) The packet ship New York, in her passage from New York to Liverpool, was struck by lightning twice in the same day, April 19, 1827. The first explosion shattered the main-royal mast and mast-head, penetrated the deck, and demolished the bulk-heads and fittings in the store-rooms below,—then dividing, one part fell upon a lead tube, which it traversed as far as the side of the ship, and passed out into the sea, starting the ends of three four inch planks;

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* Extracted from the log of the brig Mirabiles, and given to Mr. Lockyer, Comptroller of the Customs at Plymouth.

another portion passed into one of the cabins, and shivered to atoms the plate of a large mirror, without hurting the frame; after this, it fell upon a piano-forte, which it touched with no very delicate hand, and left it dismounted, and out of tune; from thence it passed through the whole length of the cabin floor, which was damp at the time, and out of the stern windows into the sea.

(*f.*) The operation of the second explosion was very different from this;—it fell upon a spike at the mast-head, and from thence passed down a small metallic chain, which it disjointed and partly fused, into the sea, without doing any damage to the vessel.*

(*g.*) His Majesty's ship Bellerophon, under the command of Captain Rotheram, was struck by lightning at sea, in August, 1807. A violent explosion took place in several parts of the ship at the same time; the main-top-gallant mast totally disappeared, except the heel; the rigging of it was cut and burned in pieces; main-top-mast shivered in splinters from head to heel; main-mast damaged, and thirteen feet of the fish on the fore-part disappeared. The explosion also fell on the mizen-top-mast, which it likewise shivered; it descended down the mizen-mast in a spiral direction, broke the hoops, and damaged the mast; it passed through the coat of the mizen-mast on the larboard side, and through one of the poop beams on the other side; it passed into the ward-room, into one of the officer's cabins, started the butt end of a plank in the ship's side, and split a rider underneath, on the lower deck. The electric matter on the larboard-hand went close into the ship's side, in a perpendicular direction, and through the main and lower decks; it cut the clamp of the main-deck beams, entered the steward's room, where it ripped up the tin lining, and then passed through the orlop-deck into the butter room. The vessel was not damaged in the final escape of the electric matter into the sea.

(*h.*) In January, 1830, H. M. S. Etna, under the command of Captain Lushington, was struck by lightning in the Corfu Channel, in the Adriatic, at the time of coming to anchor. In this instance three tremendous explosions came down a metallic chain, attached to the main-mast, and passed into the sea, without damage to the mast; the ship at the time seemed covered with sparks.

9. It may be observed by an attentive examination of these few cases, 1st, That the points *to* and *from* which the electric matter is eventually determined, are out of the ship; and, according with what has been stated in 1, 2, 6, are in the clouds and sea, so that the vessel is merely, as it were, an intervening object; the only action, therefore, which can be conceived to belong exclusively to the ship, is that which may be required to neutralize the opposite electrical state, induced upon the whole mass of the vessel, as being a point of the great surface opposed to the electrified clouds, and which is very small and of little consequence, compared with the capacity of the surrounding sea. Cases *a*, *b*, *c*, *d*, *e*, *f* more particularly show this. 2ndly, That the points through which the explosion is determined,

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* This conducting chain had been set up immediately after the first explosion happened. See vol. 2, p. 63, of this journal.

are invariably in the line or lines of least resistance between the points of action—that is, through the best conductors. Cases *d*, *f*, *h*, clearly illustrate this; and the same may be traced in all the others.

10. It may be also observed in these, as in every other case of damage from lightning, more especially on shipboard, that the greatest mischief occurs where good conductors cease; the electric matter being then enabled to produce all the disastrous effects of an expansive force, as if, whilst in the conducting body, it was in a diffused and low state, and again condensed and brought into a narrow focus, at the moment of leaving it. The damage, therefore, may be in this case considered to happen, not where the best conductors *are*, but where they *are* not; so that the mariner has to contend with a constantly exploding principle, which continues its devastations in all those points where it ceases to be transmitted; thus determining for itself a passage between the points of action through such line or lines as may, upon the whole, oppose to it the least resistance.

11. Such effects being constantly observed not only on ship-board, but on shore, it became a grand question of scientific consideration, how far it would be prudent to provide for the electric matter an efficient conducting line, between the highest points of a ship and the sea, so as to offer the least resistance to the progress of such powerful agency, and transmit in a state of low tension between the points of action; on the same principle that persons, dreading an inundation, would provide a channel to carry off the water as easily as possible; an idea, as is well known, first suggested by the celebrated Dr. Franklin, and since carried into practice with considerable success; the conducting line having the name of lightning conductor or lightning rod.

[TO BE CONTINUED.]

Report on the present state of the New London Bridge. By Mr. Christopher Davy, *Architect.*

To the Editor of the Mechanics' Magazine.

Furnival's Inn, Feb. 27, 1832.

Dear Sir,—Having on the 20th inst. minutely surveyed along with you the present state of the new London bridge, I now proceed, agreeably to your request, to state the result of that survey for the information of the public.

A very considerable degree of subsidence is always to be looked for in structures of this magnitude; and wherever such subsidence possesses one uniform bearing, there is little, if any thing, to be feared from it. In laying out the working plans of the new London bridge, it was inferred, from the soundings that were previously made, and from what had taken place in the case of the Southwark and Waterloo bridges, built over the same river, and at no great distance from the site of the present, that the centre arch and pier might settle nine inches, and each of the others eight inches; and Sir

John Rennie states, that the actual settlement falls short of this calculation, (Report to the corporation of London, Nov. 17, 1831.) It cannot be said, however, that the bridge has yet reached its actual bearing; neither is the real state of matters correctly represented, by speaking of the subsidence as merely vertical.

From the survey which we made, it appears clearly that a settlement has taken place in three different directions. The first is the perpendicular settlement of the bearing piers into the bed of the river. The second is a longitudinal settlement of the superstructure from south to north. The third is what may be called a transverse settlement of the entire structure from west to east, that is, sideways, in the direction of the stream.

The effect which these different subsiding tendencies has had on the form and appearance of the bridge, will be found accurately represented in the accompanying drawings.

Fig. 1.

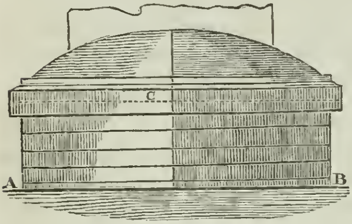


Fig. 2.

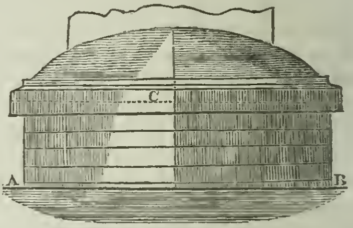


Fig. 3.

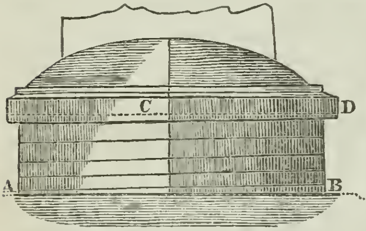
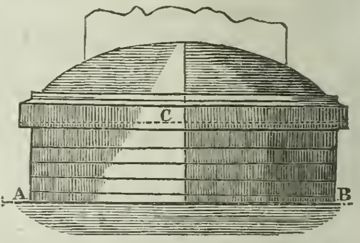


Fig. 4.



Figs. 1 to 4, represent the present elevation of the cutwaters of the different piers, beginning from the Southwark side. The dotted line, C, is a perfect horizontal line, drawn from the corner of the platband, or string course, D, of the first bearing pier on the city side, through all the others, in order to show how the piers have sunk, compared one with another. The lines A B, drawn through the different cutwaters, show how much each pier deviates from the true level. We measured accurately the height above the water (at half flood) of each of the first course of stones, at the points A and B, and found the following extraordinary variations:

Fig. 1.	Fig. 2.	Fig. 3.	Fig. 4.
A 4¾ inches.	5½	A 8½	6
B 5½	6½	B 6	9

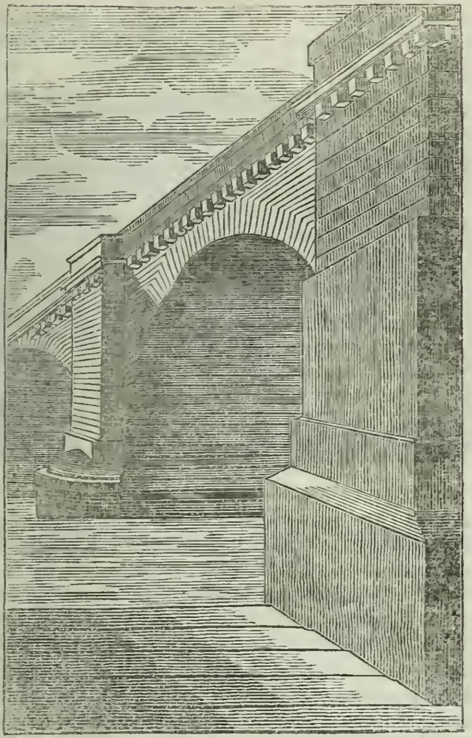
The pier and cutwater, fig. 1, has evidently been the first of the series to settle downwards; and this can only be accounted for from the lesser density of the soil on the Southwark side of the river. The south bank of the Thames was originally at this place a vast marsh or swamp, while on the city side, the ground was firm, and rose somewhat abruptly from the river. In 1823, the whole of the river bed at this part was bored under the directions of Mr. Telford, by order of the Bridge-House Committee; and the borings then made, showed that the rubbish and loose soil on the Southwark side, reached considerably below the level to which the tops of the bearing piles of fig. 1 have been driven. It has been stated, indeed, by the engineer, the assistant engineers, and contractors, that "every one of the piers was founded on very hard solid clay;" nay, that a considerable thickness of it was removed to get to the depth at which the foundations were laid: (Report of Messrs. Telford and Walker, October 17, 1831,) the excavations, too, were made within coffer dams, so as scarcely to admit of any mistake about the nature of the ground; but if the soil on the south bank were not of inferior density—something far short of "very hard and solid," how is the greater sinking on that side to be explained? I am not aware of any other explanation that can possibly be given.

The piers figs. 2 and 3, being those on which the centre arch is raised, incline towards each other; and this would seem to arise from the current being much stronger, and of much greater depth in the centre of the river than towards the sides, and from a consequent leaning to the side of least support. Sir John Rennie states, that the piers are protected from the action of the stream by "three complete rows of sheeting piles, fifteen inches square, and driven 18 feet into the ground (in addition to the bearing piles,) and extending round them for a distance of thirty feet;" and, moreover, that "the bed of the river for the same distance, is three to four feet *above* the platforms, and two feet eight inches more above the heads of the bearing piles," (Report November 17, 1831.) But on the other hand, Messrs. Telford and Walker have reported that from their "soundings in the middle of the centre arch, the bed of the river at that place is now about two feet six inches under the level of the top of the platforms." (Report October 17, 1831.) We are constrained, therefore, to conclude, that since the bearing and protecting piles were driven in, the bed of the centre of the river, must have been scooped out to the depth of some six or seven feet; and this would indicate a violence in the scouring operation of the stream, which could not fail, in spite of the protecting piles, to affect very materially the solidity of the foundations, laid bare to its action. It seems probable that this result has been very much accelerated by the circumstance of the greater part of the piles which supported the centring of the middle arch, having been subsequently withdrawn, and the soil having been thus necessarily broken up and loosened to a great depth. It is deserving of remark, that in the only other bridge over the Thames in which this plan of raising the centrings was exclusively followed—namely, that of Westminster—a similar failure took place; and that, although the piles were not wholly withdrawn, but sawn off under water. The centrings of Blackfriar's and Waterloo bridges were supported on the offsets or footings of the piers. In the case of the Southwark bridge, the centrings were partly supported on the offsets of the piers, and partly on piles driven into the bed of the river—a combination of means called for by the great span of the arches; but the piles were at such a distance from the piers, that the subsequent extraction of them did little if any harm. In no circumstances, however, can the withdrawing of piles from such places, and the disturbance of the soil consequent upon it, be considered either safe or prudent; and least of all, where there is a deep and impetuous current, such as that through the centre arch of the new London bridge to contend with.

The longitudinal settlement or leaning of the superior part of the structure, from south to north, that is, from the Southwark to the city side, is a fact at seeming variance with the southward inclination of the foundations; but it may be explained in this way. The theory of equilibrium, as applied to elliptical arches, requires that an immense weight should rest upon the haunches—the line of the extrados at that part forming an asymptote with the springing. In practice this condition is considered to be fulfilled either by loading the spandrils with rubble, or by the more approved method followed in this instance, of building hance-walls upon a considerable portion of the extrados. The necessary effect, however, of the great sinking which has taken place in the first pier on the Southwark side (fig. 1) must have been to draw off this required weight from the haunches, and to make it lean backwards and longitudinally, instead of downwards. Nor can it seem surprising that the backward pressure of so vast a body of materials, combined with the natural thrust of the arch, should communicate its influence, more or less, to all the arches and piers throughout the bridge. I think I may, with great safety, venture to assert, that if the roadway of the bridge were taken up, and the extrados of the first arch on the Southwark side examined, the hance walls would be found in a very fractured state. External symptoms of such a result are even already extremely apparent. Several of the voussoirs at the shoulders of the arch—the very part which in the case we have supposed would be first affected—have fallen out of their places, and given to the curve of the intrados the tortuous appearance represented in fig. 6. It may be proper to observe, that this distortion is not readily perceptible when viewing the bridge from the water, and that it is only to be seen properly from the plying stairs on the Southwark side.

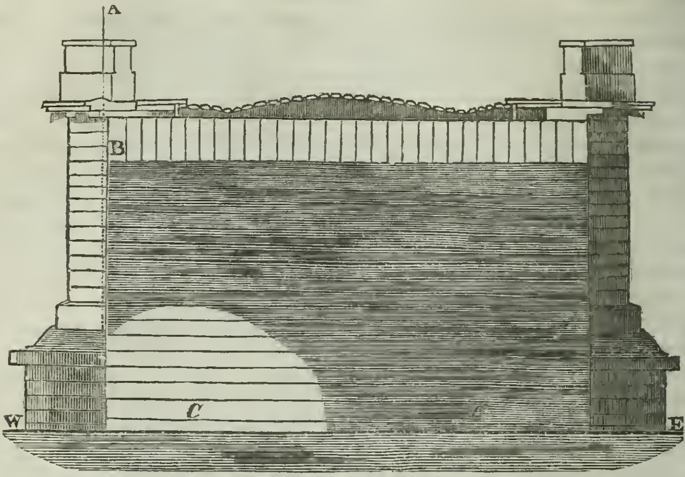
The extent of what I have called the transverse settlement—that from west to east—is represented in fig. 5, which is a section through the centre of the first arch, on the Southwark side. The line, C C, marks the varying height of the first course of stones above the water; at the west or upper end, it is eight and a half inches, and at the east, or lower end, only two inches. The dotted line A, is a correct perpendicular, showing by comparison with B, the present face of the structure, how much it has fallen from its proper vertical position.

Fig. 6.



It appears, that from the first the east side of the bridge was considered to require greater support than the other; first, because of its greater proximity to the rapids at the old bridge: and, secondly, because the clay stratum was known to be several feet lower at the east than the west side. It was accordingly deemed expedient to cut off, and leave in, two rows of the coffer dam piling, in front of each cutwater on the east side, while the dam piles on the west side were withdrawn. But this precaution has been apparently of little avail; neither was it of a nature to counteract any tendency to depression, arising from insufficiency or irregularity in the foundations, or a want of equilibrium in the superstructure. As this transverse settlement is uniform throughout the bridge, and corresponds closely with the degree of dip in the clay stratum, it is difficult to resist the conclusion, that there is a connexion of dependence between them; though in what particular way the deviation from the horizontal line has been produced must ever remain matter of conjecture. It may probably have arisen from the length of the bearing piles not having been graduated according to the dip of the strata.

Fig. 5.



The resident engineers and sub-contractors, say that this transverse settlement of the bridge has been caused by the first platform having been "laid with a small fall to take the water towards the pumps, which were fixed at the lower or east end of the first pier, and that the other piers having been set out from the first one have the same inequality;" and they add, that "the stones, after having been dressed at the Isle of Dogs, came up in pieces ready to be set, and so perfectly squared, that the variation from a level in the platform was carried up to the top of the bridge." But of this explananation, Messrs. Telford and Walker very truly observe, "it implies a difficulty of execution, which, to say the least, it is not easy to account for." "The points of the piers, the faces of the walls, and the courses of the stone work through the piers, are, with little exception, in straight lines, battering or overhanging, or sloping at the places where the irregularities are, but all nearly corresponding; that is, if the courses of stone in the piers are out of level, the ends of the piers and spandril walls to the top of the arch are nearly proportionally out of perpendicular, but still sufficiently straight, and it is not easy to suppose them to have been built so. We do not think the statement of the stones being so square, as that the work, when once begun on an inclination, naturally inclined to slope and batter to the end, without the superintendents or workmen being aware of it, sufficient to account for the irregularities to the present extent." (Report Oct. 17, 1831.)

Fortunately, the abutments at both ends of the bridge have undergone little or no variation; and should they remain firm, and the different settlements not extend much farther, no fears need be entertained for the permanent stability of the structure. They will have marred its beauty, but that will be all. Were the city abutment, however, ever to fail, the fabric has such a general leaning towards that side, that it would infallibly tumble into the river.

The parapet of the bridge was not set till a considerable time after the centres were struck, and till after the settlements before described must have made considerable progress. But it exhibits, notwithstanding, very evident traces of their disturbing influence; a circumstance from which it may be inferred that *the movement* has by no means yet reached its termination. The stones appeared to us, in a great many instances, parted to a degree, which no imperfection of workmanship, or any shrinking of the mortar from the winter's frost, could possibly account for.

It is deserving of observation, that all the imperfections which have been noticed are imperfections of execution merely, and do not in the least detract from the superiority of the elliptical principle of construction. Had it been the principle that was in fault, it would have been at or near the key-stone, that we should have found failures taking place; but though we carefully examined the voussoirs and line of intrados of all the arches, we found the upper part or crown invariably firm and sound.

Christopher Davy.

¶ *Comparative advantages of heating by Hot Water, Hot Air, and Steam.*

From minutes of recent conversations at the Institution of Civil Engineers.

Mr. Turrel said, that where steam was employed, it was requisite that a strong heat should be kept up under the boiler, in order to have a continued flow through the pipes, for as soon as the fire fell low, the steam was condensed, and they, becoming empty, were no longer serviceable for heating. With water, on the contrary, so long as there remained the smallest heat in the boiler, that temperature would be equally distributed over the whole house; the water still continuing to circulate, until it cooled down to the temperature of the atmosphere.

Mr. Simpson said, that the method of heating rooms by warm water, possessed a decided superiority over any other, from the comparative security it afforded against accidents by fire; he had known instances of hot water pipes being introduced into bankers' houses, (where they are extremely fearful of fire,) after they had objected to the use of flues, or pipes conveying heated air, or steam.

Mr. Cottam said, that no experiments had been tried hitherto, by which could be ascertained the quantity of fuel necessary to produce a given temperature on the pipe, or in the atmosphere of a room which was heated by its means. He thought it very desirable that a statement of the relative consumption of fuel should be obtained, as, in some observations on the performance of a hot water apparatus attached to a pinery, that consideration was overlooked. He could state one instance of a house that he had fitted up with a set of hot water pipes, by which a saving of one-third was effected in the consumption of fuel; here, however, the flue, which was in use previously, had been of faulty construction; this, therefore, ought not to be considered as decisive. He stated, that no beneficial effect was produced by leading the flue from the fire, along the brick wall; there was no apparent increase of temperature in the house.

Mr. Sibley described a hot water apparatus he had fitted up, which warms several rooms, boils a cistern, and heats a bath on the top of his house; this is managed by a boiler being placed behind the kitchen fire, and which, in fact, forms the back of the kitchen range; from this a common two inch gas pipe is conducted round the rooms to the top of the house, a height of fifty feet, and returned to the boiler. He stated, that although considerable heat must be withdrawn from the fire by this apparatus, and the consumption of fuel probably increased, yet no inconvenience was felt from its operation.

Mr. Turrell observed, that he had been in the practice for many years of heating his office with a hot air stove; it was found to create an unpleasant smell, and the atmosphere of the room eventually proved extremely hurtful to the lungs. He adopted a plan of evaporating a portion of water during the whole of the time the stove was in operation, thereby keeping up a proper degree of moisture in the atmospheric air; this removed every injurious effect which was before observable.

Mr. Field said his offices were heated by means of steam pipes, and that it created a most unpleasant smell, accompanied by a feeling of oppression on the lungs. He thought the hot water pipes preferable, on account of the greater uniformity of temperature which was afforded, and always of a very moderate degree: that from steam pipes, on the contrary, was always high, and more difficult to regulate.

Mr. Clegg had been employed to correct the unpleasant smell, created by the air in coming in contact with the red hot surfaces of iron stoves. He adopted a method of covering the stove with a kind of glazed tiles, which was found to be very effective.

Mr. Hawkins had known an instance of a cotton mill, in which it was found impracticable to spin any fine description of thread, on account of the state of the atmosphere, produced by the artificial heat. A scientific man gave as his opinion, that a deficiency of moisture affected the electrical condition of the atmosphere, and was the cause of the difficulty of working the cotton into fine thread. Mr. Hawkins was of opinion that the oppressive feeling spoken of, was more to be attributed to the circumstance of a supply of moisture being necessary for conducting the electricity from the human body than to the fact of the air being burnt or decomposed.

[*Athenæum.*

¶ *Method of Transferring Prints from Paper to Wood.*

Sir,—A method of transferring lithographic prints from paper to wood, was discovered sometime back in France; the process has been imported into this country, and is at present extensively employed for the purpose of ornamenting white wood articles of various kinds, and forms a favourite amusement of the fair sex.

It having occurred to me that a brief description of the process might be acceptable to some of your readers, I beg leave to place the following at your disposal.

In the first place, the article on which the print is to be transferred, should receive a coat of spa—or, of the transfer varnish, allowing a sufficient time for it to become dry: this greatly facilitates and improves the transfer, and also preserves the wood from soil or stains during the process. Having cut away as much as possible of the superfluous paper from about the print, place it in a vessel of clean water until it is completely saturated, which will be in about five or ten minutes; then place it between blotting paper to remove the superabundant water from its surface. This done, with a flat camel's hair brush spread the transfer varnish* equably over the surface of the print, and apply it immediately to the wood; lay a sheet of writing paper upon it, and rub it all over with the hand, using pressure, that the necessary adhesion may take place.

With the fingers, dipped from time to time in water, peel off the paper by continued rubbing, proceeding with more caution as the print begins to appear. The rubbing and washing should be continued until the whole of the paper is removed; when dry, a coat of spa varnish will bring up the print.

If the article is to be polished, continue to apply the varnish until a sufficient body is obtained for that purpose, taking care that each coat is dry previous to the application of the next. When the whole is perfectly dry and hard, take pumice stone in an impalpable powder, and with a piece of serge moistened with water, polish until a smooth even surface is obtained. Then take the finest tripoli, and with a piece of fine cloth, and some olive oil, continue the process until a high degree of polish is obtained, when the oil must be wiped off with a soft linen cloth, and the surface cleaned off with starch powder, or with Spanish white.

It is but seldom, however, that persons polish their articles themselves, more patience and practical dexterity being requisite for the success of this process, than falls to the lot of every one; varnishing, is, therefore, a distinct occupation, performed by persons who make it their sole business, and who, therefore, attain great skill in the process.

In the above way all kinds of plain or coloured prints may be transferred to wood; but when coloured prints are used, it is necessary to employ an acid solution instead of water, to destroy the size which exists in all papers of coloured prints. For this purpose mix two-thirds of vinegar with one-third of water, and with it moisten the back only of the print, proceeding with the transfer as before directed.

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* Prepared by George Gardom, and J. W. Williams, Philadelphia; and probably by other persons in most of our cities.

The transfer process bears a considerable resemblance to lithographic printing, and it is most likely that the idea was suggested by it. The *rationale* of the process is as follows: the paper being saturated with moisture, does not unite with the transfer varnish, but the ink being of a greasy texture is impervious to the water, and is therefore taken hold of by the varnish, and securely fastened to the wood; the paper not being so held is washed away with comparative ease, leaving the ink imprinted upon the wood.

W. Baddeley.

London, *April* 3, 1832.

[*Mech. Mag.*

New Lamp.

In the course of the first meeting, at York, of the British Association for the Advancement of Science, the Rev. Wm. Vernon Harcourt, on the 1st of October last, showed a lamp constructed upon a new principle, and explained the principle and construction of it: he gave it the name of an *oil gas lamp;* not because it was lighted by gas formed at a temperature below that of flame, (for this was common to all lamps,) but because, as in the gas lights of the streets, the gas issued from a reservoir, and owed the perfection of its combustion not to an ascending current of hot air, but to the force with which it was propelled from the reservoir and carried the air along with it. It differed from the common gas lights in these circumstances:—that the reservoir formed part of the burner; that the gas was formed as it was consumed; and that it was propelled not by a *vis a tergo*, and in a state of condensation, but by the expansive force of its own heat. In consequence of this circumstance, the current of the gaseous jet was more rapid in proportion to the quantity of matter contained in it than in the common gas lights, whilst it was also at a much higher temperature, so that it could issue with a greater velocity without being liable to blow itself out. The practical difficulty of the construction consisted in the obtaining a steady supply of oil, especially with the cheap oils. This difficulty had been in a great measure surmounted, but the instrument was still imperfect, and had been charged by some accident that evening with a vegetable oil, from which a clear light could not be obtained.*

[*First Rep. of British Asso. for Advanc. of Science.*

* At p. 188 of vol. ix. there is a description of an oil gas lamp, invented and patented by Solomon Andrews, M. D, of Perth Amboy, on the 15th of April, 1831. So far as the above article describes the "New Lamp," it appears to correspond precisely with that of Dr. Andrews. This lamp has been further improved by the inventor, who obtained an additional patent therefor on the 10th of May last. The editor has one of them in his possession which affords a brilliant and clear light, and upon which he is experimenting with a view to the testing of its comparative value, which he intends to publish at an early day.

Bone Dust for Cultivation of Grain.

The exportation of bones from Germany to England, constitutes a singular epoch in the annals of commerce. Myriads of tons have been already exported without glutting the market, or causing a cessation of the demand. In the vicinity of the North Sea mills have been erected to pulverise them. This bone powder, or bone dust, was long ago exclusively applied to the purposes of hot houses by German horticulturalists; but the English, emboldened by their riches, have extended its use to general objects of agriculture, and fertilize, by these expensive means, their cold, humid, and poorest land; and have thus brought the uplands of Nottinghamshire, the western parts of Holderness, &c. into the highest state of cultivation, both in point of extent and intenseness of fertility. There is, consequently, a proverb, "that one ton of German bone dust saves the importation of ten tons of German corn." As Malta formerly covered her naked rocks with foreign soil, so does England now fertilize her clay and sandy heaths with German bones. Near the sea coast even the church yards are robbed of their venerable relics, which is only ironically excused by rendering the German bone trade popular. An agriculturalist, being rendered attentive by this vast exportation, instituted privately some comparative experiments, the results of which prove that bone dust acts in the cultivation of grain, as compared to the best stable manure—1. In respect to the quality of corn as seven to five. 2. In respect to quantity as five to four. 3. In respect to durability of the energy of soils as three to two. It produces several collateral advantages—1. It destroys weeds. 2. It diminishes the necessity of suffering the land to lay fallow. 3. This concentrated manure, or substitute for manure, is more easy of conveyance, less laborious to spread, and can with facility be applied to the steepest vineyards or other inaccessible lands either in mountainous countries or in wet meadow land. 4. It renders agriculture practicable without cattle breeding, grazing, &c. [*Rep. Pat. Inv.*

¶ *Analysis of Maillechort.*

An alloy which resembles, pretty well, silver and polished platina, has been manufactured for some years at Paris; it evidently resembles the German silver, now extensively employed in England. M. Dumas, (Jour. de Pharm. Feb. 1832,) gives the annexed analysis, which will show that it differs not very materially from that of the German silver, given some time since in the Mechanics' Magazine.

Maillechort.		*German Silver.*	
Copper,	66.	Copper,	53.9
Zinc,	13.6	Zinc,	29.13
Nickel,	19.3	Nickel,	17.48
Iron and sulphuret of arsenic	trace		
Loss,	1.1		100.00
	100.0		

Papers on *white Copper*, which is an alloy similar to the above, will be found in the Philosophical Magazine, vol. 63, p. 119, and vol. 64, p. 73. [*Philo. Mag. April*, 1832.

¶*Expansion of Iron Pipes by Heat.*

From minutes of recent conversations at the Institution of Civil Engineers.

Instances of expansion in iron pipes of various lengths, caused by an elevation of temperature were adduced. A set of pipes at Manchester, two hundred yards long, was observed to expand to the extent of seven inches. A pipe of one hundred and eighty feet long expanded one inch and three quarters, from change of temperature. [*Athenæum.*

Meteorological Observations for July, 1832.

Moon.	Days	Therm.		Barometer.		Dew point	Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise	2 P.M.	Sun rise.	2 P.M.		Direction.	Force.		
				Inches	Inches.				Inches.	
	1	63°	92°	30.10	30.05	68	W.	Breeze.		Light clouds.
	2	67	94	.00	29.90	62	SW.	do.		Clear day.
	3	72	92	29.90	.80	57	NNW. W.	do.		Light Clouds.
☽	4	70	90	.85	.90	55	W.	do.		Clear day.
	5	63	90	.90	.90	57	SSW. W.	do.		Clear day.
	6	73	90	.90	.90	61	SSW.	do.		Lightly cloudy—clear.
	7	70	92	.90	.80	73	SSW. W.	do.		Light cl'ds—Therm. at 12
	8	70	89	.80	.70	66	E. S.	do.		Cloudy—clear. [94
	9	63	67	.70	.65	66	E.	Calm.	.07	Cloudy—rain.
	10	64	77	.65	.65	58	W.	Breeze.		Cl'dy: fly'g cl'ds; thund.
	11	56	63	.65	.65	55	W. E	do.	1.00	Showery. [sh'w'r.
🌕	12	56	71	.65	.65	52	W. N.	do.		Clear—flying clouds.
	13	58	77	.65	.65	52	W.	do.		Clear—sh'w'r—high wind
	14	57	80	.70	.80	52	W.	do.		Light clouds.
	15	58	80	.90	.90	50	W.	do.		Clear day. [shower.
	16	60	76	.90	.90	57	W.	do.	.03	Clear; overcast; thunder
	17	62	83	.94	.96	66	SSW.	do.	.01	Clear; light clouds; rain.
	18	64	89	30.00	30.00	65	W.	do.		Cloudy—clear. [high.
	19	69	81	.00	29.70	62	W.	do.	.48	Clear; thund. sh'wr. wind
	20	68	87	29.60	.60	64	W.	do.	.04	Clear day; sh'w'r. ev'n'g.
☾	21	69	89	.60	.60	56	W.	do.		Clear—flying clouds.
	22	62	80	.70	.70	54	NNW.	do.		Clear day.
	23	59	81	.90	.95	55	S.	Calm.		Clear—flying clouds.
	24	61	72	.95	.90	65	S.	do.		Cloudy—drizzle.
	25	70	82	.73	.71	51	W.	Breeze.	.04	Fly'g cl'ds. clear; lt. rain.
	26	62	76	.70	.70	55	W. N.	do.		Clear—flying clouds.
⊗	27	60	82	.86	.95	51	W.	do.		Clear day.
	28	60	80	.95	30.00	58	W.	do.		Clear—flying clouds.
	29	66	84	.90	29.90	65	S.	do.	.40	Lightly cl'dy; clear; rain
	30	65	82	.80	.80	64	W.	do.		Cloudy—clear [in night.
	31	66	83	.85	.90	63	WNW.	do.		Light clouds—cloudy.
	Mean	63.97	82.29	29.83	29.81	55.4			2.07	

	Thermometer.	Barometer.
Maximum height during the month,	94. on 7th.	30.10 on 1st.
Minimum do. . .	56. on 11th & 12th.	29.60 on 20th and 21st.
Mean do. . .	73.13 . .	29.82

JOURNAL

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OF THE

State of Pennsylvania,

DEVOTED TO THE

MECHANIC ARTS, MANUFACTURES, GENERAL SCIENCE,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

OCTOBER, 1832.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Alarm to be applied to the interior Flues of Steam Boilers. By A. D. Bache, *Professor of Natural Philosophy and Chemistry in the University of Pennsylvania.*

Both experience and theory point out sources of danger to which boilers with interior flues are particularly liable. As economy will probably lead to the continuation of the use of these interior flues, in boilers of certain sizes, means of safety should have reference to this particular kind of boiler, now in such general use, as well as to those of a different construction.

The objects of interior flues, are well understood. They serve, more or less perfectly, to place the heated gases from the furnace in close proximity to the water of the boiler, and to retain them thus until they can no longer be used advantageously to impart heat. The form, number, and position of these flues are varied to suit the size of the boiler, or the peculiar views of the constructor.

As an example of this kind of boiler, one may be taken in which the draught, after passing under the boiler from the fire end to the back, returns through a flue, within, to the front, where it leaves the boiler. This is a favourable case for safety in this mode of construction, for the flue is not so liable to be unduly heated as when it serves, throughout its length, as a passage to flame. The construction itself, however modified, exposes peculiarly to the danger consequent upon a depression of the water within the boiler below its proper level. The flues, particularly in the small high pressure boilers in which they are so commonly used, cannot be placed much below the habitual level of the water, and though they present convex surfaces of small diameters, a small depression in the level of the water, after the top line of the flue has been uncovered, exposes a considerable surface.* In such a case, the parts of the exposed surface not adjacent to the water line, being in contact only with steam, which conveys heat from them but slowly, become unduly heated, and, on a considerable increase of temperature, lose their tenacity. If water now obtain access to the heated metal, from any of the causes so often stated, the pressure of the steam suddenly generated must, if the boiler be, from construction or relative temperature,. stronger than the flue, cause a collapse of the latter.

When several boilers are placed side by side, and communicate freely with each other, which is the case in many of the boats on our western waters, the careening of the boat,† if sufficiently long continued, as at a landing, &c. will, by partially emptying the boilers on the higher side, produce the circumstances to which we have alluded. The coincidence of such observations with the fact of the occurrence of so many explosions just after leaving landing places, is too striking to pass for accidental.

A large boiler, with flues not in the centre, would be similarly situated with those just described, under like circumstances.

In vol. vii. p. 217, of this journal, I proposed a method by which the fusible metal plate might be applied to steam-boat boilers without risking the safety of the boat, when, under peculiar circumstances, the plate should give way.‡ A plate attached to the boiler would serve only indirectly, if at all, as a means of safety to the interior flues of the kind of boiler which we are now engaged in discussing. A more direct application is wanted to meet the peculiarities of the construction. Besides, the objects to be accomplished in relation to the boiler and to the flue are different. A fusible plate applied to a boiler is intended to act in two different states of the steam within. The first is when the steam is saturated, and has, therefore, an elastic force corresponding to its temperature: the second, when from a deficient supply of water, the boiler becomes unduly heated, and communicating its heat to the steam within, the latter is surcharged. In the first case, the plate acts as a check upon the common safety valve and allows the escape of steam when the valve has not done its duty. In the second case, the steam should be suffered to escape only to furnish an alarm, since its continued flow would tend to increase the evil; of the existence of which it had given notice. Means should, therefore, be provided for at once checking the escape of steam in this latter case.

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* A depression of one inch below the top of a flue nine inches in diameter, and placed horizontally, would expose, for every inch in length of the flue, about 6.1 square inches of surface. A flue twelve inches in diameter, under the same circumstances, would expose rather more than seven square inches, for every inch in length.

For a depression of only one-fourth of an inch, the first flue would expose, for each inch in length, about three square inches, and the second between 3.4 and 3.5 square inches.

† See Williams on "obviating or lessening the accidents incident to Steam Navigation." Journal of Franklin Institute, vol. viii. Also Cadwallader Evans' communication to Committee on Explosions, Journal of Franklin Institute, p. 89, vol. ix. It is due to Mr. James J. Rush, of Philadelphia, that the fact should be known, that he presented to the Committee on Explosions, at one of their earliest meetings, a drawing exhibiting this defect, for which he proposed a remedy.

‡ Since the publication alluded to, the Society for the Encouragement of National Industry, in France, has awarded a silver medal to Edward Hall, of Paris, for an application of the fusible plate which fulfils one more condition than the method which I proposed, and is thus superior to it. I shall take occasion to communicate a description of this invention.

Fusible metal applied to a flue is to act as a warning thermometer, to inform the engineer when, by any accident, the temperature of the flue is raised above the proper point. This taking place when the supply of water is already defective, any escape of steam is objectionable, since it still further diminishes that supply: it is more objectionable than in the case of the boiler, as the relative situations of the surface of the flue and boiler to the water, cause a more considerable extent of surface of the former than of the latter, to be laid bare by a given depression of the level of the water below the top of the flue.

Different methods have been suggested of applying fusible metal to the flues of boilers. It has been proposed to apply a fusible plate directly to the flue: to such a plan the strongest objection is that the contents of the boiler would be discharged, with more or less violence, through the opening made by the fusion of the plate, even if the water were below the level of that opening. If this should fail, in the case of a high pressure boiler, to produce the destruction of human life, it would, in all cases, expose to the delay necessary to a complete cooling of the boiler, and to the replacing of the plate; it might occur at a time when the desertion of the prime mover would be as dangerous as an explosion.

Arrangements which require the access to the boiler to be cut off by stuffing are, in general, bad, when the parts passing through the stuffing box are to serve as an alarm, and are to be moved only at distant intervals, exposing them to adhesion from change in the packing, or from oxidation. The proposal of an anonymous author to apply to the flue a mass of fusible metal, in which the lower end of a rod should be fixed, the upper end passing through a stuffing box on the boiler, is liable to this objection. Besides this, however, there are others, foremost among which stands the effect of galvanic action, which, according to the metals used, would oxidise the flue itself, the rod, the fastenings of the fusible metal, or one or more of the components* of the alloy.

The tubes terminated by fusible metal, proposed by Mr. Ewbank,† are, in my opinion, superior to either of the methods just examined: by extending them to the vicinity of the flue they might be so prepared as to melt when it should become unduly heated: the tubes being small, the escape of steam would not be important. The tubes would be exposed to the effects of galvanic action, and when the ends were once fused, could not, conveniently, be renewed while the boiler was in action.

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* The order in which iron and copper, the materials of boilers, rank with lead, tin, and bismuth, the components of fusible alloys, in the electrical series, is as follows: copper, bismuth, tin, lead, iron, the last named being electro-positive with regard to those which precede it. (Berzelius, traité de Chimie, tome iv. p. 571.

† Journal of Franklin Institute, vol. x. p. 1.

The following apparatus combines the requisites of giving warning when the temperature of the flue reaches a determinate limit; of not producing, necessarily, the escape of steam; of being free in its action; and of being renewed with great ease, after having given warning.

A tube of iron or copper, closed at the lower end, passes through the top of the boiler, its closed end reaching the flue, to which it is attached. The material of the tube will depend upon that of the boiler. This tube, it will be observed, affords a ready access to the flue, to ascertain its temperature, without any restraint from packing. Such tubes were used by Dulong and Arago in their experiments on the elasticity of steam at different temperatures, (and, also, by the committee of the Franklin Institute on Explosions,) to ascertain the temperature of the steam and of the water within their boiler. For this purpose, they were partly filled with mercury, into which a common thermometer was plunged, and thus conveniently placed or removed while its bulb was not exposed to the pressure of the steam.

A mass of fusible metal placed at the bottom of the tube, described in the beginning of the last paragraph, will become fluid very nearly as soon as the flue takes the temperature of fusion of the alloy. I would, in passing, note a point in relation to fusible alloys which is of great consequence in these kind of applications, and which, from some experiments, I have reason to believe may be attained; namely, that the proportions of the component metals should be so adjusted that the alloy will change its state, from a solid to a liquid, without going through a series of slow gradations.

The alloy contained in the tube might have its fusing point at thirty degrees Fah. above the working temperature of the steam. This, for a low pressure engine, working at two atmospheres, would allow a range of more than one atmosphere above the working pressure, before it fused; putting out of the question the fusion of the metal by ordinary variations in the temperature of the water surrounding the flue. In a high pressure engine working at eleven atmospheres interior pressure, the fusing point of the alloy being placed at thirty degrees above the working temperature would not exceed 397 degrees Fah. Larger limits might be taken without incurring danger, should practice show that these are inconveniently small. The object not being to give notice when the steam is saturated and highly elastic, and the water, therefore, the same temperature as the steam, the fusing points of the alloys should be considerably above those of the plates attached to the boiler, and above the temperature corresponding to the pressure for which the safety valve is loaded. The case to be met by the apparatus is that in which the flue itself becomes unduly heated.

To show when the metal at the bottom of the tube becomes fluid, a stem is attached with a cord and weight, or, as shown in the annexed cut,* with a lever and weight. The weight and longer arm of the lever, in descending, may be made to ring a bell, or, by appropriate attachments, to turn a cock, permitting just enough steam to issue to give the alarm, and then to be closed at once. A projection on the lower end of the rod prevents it from being drawn from the metal until this latter is fused, and by widening the lower part of the tube, making it slightly tapering, the metal is kept from being drawn out by the rod.

When the alloy has fused, indicating an undue heating of the flue and its cause a defective supply of water, it is only necessary at the time of giving the required supply to remove the weight and return the rod to its position in the fusible metal, which, as it congeals, will enclose it: by replacing the weight the apparatus is again prepared to do its duty. The solidifying of the metal will show when the temperature of the flue has been duly reduced. Should this be ascertained by sounding with the rod itself, it might be drawn out just when the metal was in the act of congealing, and thus its return to its place be prevented. This would destroy an important quality of the apparatus, and to avoid such a chance a wire should be provided with which to sound, for the purpose of ascertaining the state of the alloy. In the event of such a mischance, or of any circumstance which should solidify the metal before the rod could be returned, it is not difficult to see how the small quantity of alloy might be rendered entirely fluid: such a case, although it should be provided for when accident may produce it, should be avoided by the attention which would almost insure its non-occurrence. I have spoken of the melting of the alloy as indicating a deficiency of water in the boiler, since this would generally be the cause producing its fusion. Another cause should not be passed without mention, as it may lead to a peculiar location of the tube, namely, the effect of the sediment sometimes allowed to deposit upon the flues. This sediment interposes a stratum of imperfectly conducting matter between the metal of the flue and the water; the heat thus prevented from passing to the water, accumulates in the flue and leads to a dangerous state of things. These circumstances ordinary care may prevent, and in the intermission of that care notice of the approach of danger may be derived from the action of the alarm. Such a case is an extreme one, requiring nothing less than a cleansing of the boiler to remove risk; the checking of the fires, if not their extinction, should follow a warning given, when the water was ascertained to be at its proper level, or when the introduction of more water did not cause the alloy to recongeal. It cannot be expected of any device to provide a remedy for the negligence which would allow the accumulation I have supposed; a notice of its existence would be neglected at the peril of all concerned.

Unless a boiler be made of very undue thickness, never the case in practice, the metal itself can hardly oppose sufficiently the passage of heat from the parts in contact with the flame to those in contact with the water, to produce any dangerous accumulation of heat.

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* See page 223.

In determining the position of the tube reference should be had to the construction of the boiler. If the flue be inclined, the proper position for the tube, intended to meet the case of undue heating from a deficient supply of water, would be upon the higher part, as likely first to be laid bare. In reference to the deposit different modes of construction would require different locations, which might render necessary a separate apparatus from the former.

For the use of the engineer, a second tube may be provided, at the side of the first, to contain an alloy fusing at a low temperature,* or mercury when it could be used, into which a thermometer being plunged would show the temperature of the flue. A similar device, already alluded to, being conveniently placed, will give him the temperature of the steam within.† If a thermometer be deemed too fragile an instrument to be used in this place, an alloy less fusible than the one used in the proposed alarm, may be similarly applied, its indications being given to the engineer alone. Before referring to the cut for a detailed explanation of the apparatus which has been, in a general way, described, it may be well to pass in review some of the points which should meet with attention in its construction.

Of the first importance is to be considered the connexion of the tube with the flue so as to prevent the introduction of sediment between them. This may be accomplished, among other ways, by providing a projection at the bottom of the tube over which a ring being passed (as shown in the cut) and secured to the flue, will attach the tube closely to the latter. If the tube, thus connected with the flue, should pass by a screw joint through the top of the boiler, any change in the position of the flue would tend to separate the attachments of the tube or the parts of the tube itself. To provide against this the tube should pass through a stuffing box on the top of the boiler; this would allow it to move, the fastening to the flue remaining firm. This box, it should be observed, is in nowise connected in its action with the parts of the alarm. The movement of the tube will render necessary a small allowance in the position of the lever with respect to the bell.

The tube should be made as small in diameter as is consistent with the free action of the rod. The water is excluded from the space on the flue occupied by it, and if this space were considerable the temperature of that part of the flue would be higher than that of the rest. The tube must be so small that the metal may not fuse when the flue is covered with water.

If a bell be used in connexion with the stem and lever, the weight attached to the longer arm of the lever should enable it to raise the rod, and to overcome, with certainty, the resistance of the spring to which the bell is fastened.

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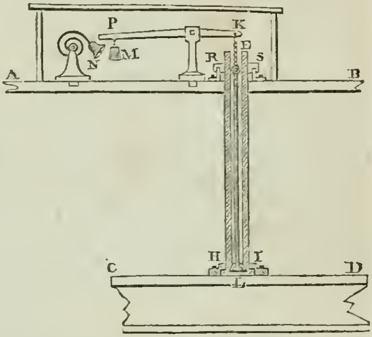
* Two parts, by weight, of bismuth, and one of tin, give an alloy which fuses at 200 degrees Fah. The fracture of the thermometer by the congelation of the alloy, in an open tube, need not be feared.

† The use of the thermometer has been most judiciously insisted upon by Professor Renwick in his work on the steam engine.

A cover should be used to prevent the access of rain to the tube, and the whole apparatus should be inclosed in a grating that it may not be tampered with; the captain of the boat should have the key of this grating.

If this apparatus were applied to the connected boilers of our western boats, the frequency of the action of the alarm, when the flues become bare by the careening of the boat, might lead to a neglect of its indications. The apparatus would then merely give notice of what ought to be known without it, namely, that the higher boiler, or boilers, have a defective supply of water and are becoming unduly heated.* That these circumstances are not always accompanied with danger no one contends, and that some plan must be adopted by which the evil spoken of may be remedied is as clearly admitted. As long as human life is thus trifled with by permitting the known and frequent recurrence of danger, alarms of any kind must be useless. The defects incident to these boilers† must be remedied before this or any other alarm can be usefully applied to them.

Annexed to the cut, which follows, are references giving a more detailed description of the apparatus.



A B is a section through the top of a boiler; C D, a corresponding section of its flue. E H represents a tube closed at the lower end, which is attached to the upper side of the flue. The mode of attachment by a projection on the tube and a ring screwed to the flue, is shown in the cut; as also the stuffing box, R S, through which the upper end of the tube passes. The lower part, H I, of the tube, is made tapering, to retain the fusible metal. K L is the stem, the lower part being inclosed by the fusible metal, the upper part attached by a chain to a lever K P. The weight M draws the rod K L upwards, and on the fusion of the alloy H I, carries the lever below the bell N, which, being attached to a spring, rings an alarm. The apparatus is inclosed in a grating; that part of the top which is above the tube should be so made as to prevent the admission of rain to the tube.

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* For this, and other judicious remarks, I am indebted to the kindness of a friend, to whom a description of the apparatus was submitted before publication.

† For proposed remedies, see the papers of Messrs. Williams and Evans, before referred to.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Practical Observations on the good and bad properties of the Colours used by Artists. By JOSHUA SHAW.*

(Continued from p. 10, vol. ix.)

In pursuing my observations on colours, I shall next notice that denominated Antwerp blue, which consists principally of cobalt, apparently in a semi-vitrified state, combined sometimes with alumina and sometimes with Prussian blue, generally with the latter, which forms about eight, or from that to fifteen per cent. of the article of commerce. It is extensively used by the manufacturers of paper hangings, and has within a few years, got into some favour with the artists. It is not so opaque as Prussian blue; and on the whole is a preferable colour; it is very manageable and pleasant to use; when reduced with white it exhibits an inclination to green, more or less; the very best to be met with has this failing. Portrait painters make a free use of it in their draperies, and frequently depend upon it for the gray tints of the flesh, combining it with Indian red, brown ochre, calcined vermilion or lakes. It should never be used except for draperies, the green foliage of trees, or such objects as have no standard by which its liability to change can be detected. In flesh tint, where the carnation merges into gray, there are very few colours indeed which can be relied upon, however carefully attended to, and that do not, in the course of two or three years, verge into a green, destroying the entire effect, and giving the subject a sickly appearance.

The only unchangeable blues are, first, the ultramarine, or ultramarine ashes, the latter, however, is for the most part liable to objections which I shall notice under its proper head. In my preceding observations, I have mentioned indigo as a valuable substitute for Prussian blue, and I shall here introduce it again as a substitute for ultramarine ashes. I have made many experiments with it, and all of them go to prove it a most valuable colour. Once being short of both ultramarine and the ashes, I charred some fine Spanish indigo in a crucible, which I afterwards ground in oil, and ventured to use it, at risk, and found, after several years, that it fully answered my expectations. When combined with white, it as much resembled the ultramarine ashes as could be well imagined, and it suffered no visible change after many years; I tried it in every possible way to put it to the test, and it still continued the same; it was not affected by the sun, and to this day I have recourse to it whenever I am short of the only superior article, ultramarine, or good ashes. If, therefore, economy is to be the order of the day with artists, it may, in the absence of the other, be relied on as a safe colour for the gray and pearly tones which are so frequent, and which form such an exquisite variety in the fairest complexions of the softer sex.

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* The first essay under this title will be found at p. 10 of the last volume; an accident which happened to the writer has retarded the appearance of the second, and his absence from this country will occasion some delay in their continuance; it is his design, however, to complete the series as early as circumstances will allow.

I once had occasion to copy a fine landscape by David Terniers, and it was the only colour by which I could truly imitate his chaste and silvery tints; reduced with white it matched most exactly the silvery blue sky, and broken with fine calcined Roman ochre it made the dark cloud tints, the distances, &c. &c.

But to return, Antwerp blue, like Prussian, may be occasionally used in broad draperies broken with white, after the manner previously recommended in the use of the latter, and rendered very permanent by a thin transparent coat of ultramarine glazed over it. It is nevertheless but an indifferent article to rely upon as a universal attendant on the palate, and should be confined to foliage, broad draperies, &c. &c.

The next blue, in respect to rank, is Cobalt blue, as it is called, but which assumes a great variety of forms, and is not always in commerce the true or genuine article. Fine blue pigments have of late years been much speculated upon, and chemists have made many discoveries, some of which are very valuable, having produced colours contending for rank with ultramarine ashes; others again are but sorry imitations of cobalt, and by which the young and inexperienced artist is frequently duped both of his money and reputation. I shall, however, in my next, endeavour to put him in possession of such facts as will assist him in the choice of this article, and the best mode of applying it in practice.

If, in my explanations, I have apparently digressed a little from one subject to another, I have done so for the sake of comparison, and with a view to assist the artist, who will, perhaps, understand me better than he would were I to attempt a perfectly methodical arrangement, or trite classification of the materials described. I am very sensible that men of science may consider my essays as too desultory, but if I am understood by those for whom I write, I shall at least render them a service, and in so doing shall have accomplished every thing which I proposed when I undertook my present task.

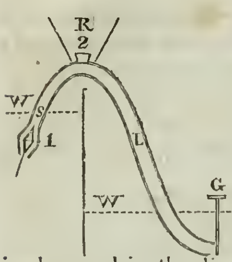
FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Proposed Improvements in the construction of the Syphon.

The following remarks relative to some proposed improvements in the construction of the syphon, is submitted to the consideration of the committee on publications by DANIEL LIVERMORE.

The operation of the syphon when made on a large scale is liable to obstruction by an accumulation of air within, which prevents the continuity of the water near its summit. This defect may in a great measure be obviated by the following arrangement. Place a valve near the lower end of the shortest leg, to open upwards, and another smaller valve on the top of the syphon, likewise opening upwards, and enclosed within a funnel shaped reservoir, the passage from which to within the syphon is closed by shutting the valve, or when open the water may be admitted from said reservoir, and retained within until the syphon is filled; the outlet being closed by a gate or sliding valve fitted to the end of the longer leg, which remains shut until every thing is ready for operation.

The manner of operation will be more readily explained by reference to the annexed sketch.



Let the dotted lines W, W, represent the surface, below which S and L receive and discharge the water.

The stop gate G being closed, and the valve 2 open, the syphon is filled by pouring water in at R. When full the valve 2 is placed on its seat, and covered by the water left in R, to prevent the admission of air. G being raised, the water ascends through S, and descends L to the outlet. If any considerable diminution is observed in the discharge, we may conclude it is occasioned by an accumulation of air within the syphon.

By closing G the valve 1 will likewise be closed, but before this can be effected, if the stoppage at G be sudden, a concussion is produced by the continued action of the water, which forces itself with any air which may be within, through the valve 2, leaving the syphon free to act with renewed energy. The valve 1, if made in the form of a double cone (as here represented,) and properly proportioned, gives, when opened to the extent permitted by its tail piece, an undiminished water way, without *increasing the internal area* of this section of the syphon. This I believe is considered desirable by philosophers, but in many cases a contraction of the water way is not so important but that a plain valve of ordinary construction might be substituted. For most practical purposes the syphon is made on a small scale, and the outlet may more conveniently be closed by a stop cock than with a sliding valve.

The entrance and discharge of the water might be considerably facilitated by adjutages of proper construction; and for a syphon on a large scale, may probably be applied with considerable advantage.

FRANKLIN INSTITUTE.

Explosions of Steam Boilers.

(No. XXIX.)

New York, July 30, 1832.

TO THE COMMITTEE ON EXPLOSIONS.

Gentlemen,—Presuming that some account of the recent disaster on board the steam-boat Ohio, would be acceptable to you, the following is respectfully submitted. As I believe this explosion was the natural consequence of a defective construction or arrangement of the internal flues, and as the same plan is adopted in nearly all our new boats, and in a majority of all others belonging to this city, it is of immense importance that the true character of this "*plan*" be ascertained and made known.

Very respectfully,
THOS. EWBANK.

Explosion of one of the boilers of the Steam-boat Ohio.

An explosion occurred in one of the boilers of this boat on Friday evening, July 6, when near Sing Sing, on her passage hence to Albany, by which five more of our citizens have perished. This is the fifth disaster of the kind reported in the course of the present year, and every one of which, it is believed, accompanied with loss of life.

I precede my remarks upon this explosion by a letter from the captain of the boat to the editors of the daily papers, and by the testimony given before the coroner's jury.

"*Steam-boat Ohio, July* 7, 1832.

"GENTLEMEN,—On our passage up yesterday afternoon, an accident occurred on board of the boat under my command which is much to be deplored. A short distance from Sing Sing, while under a common head of steam, and plenty of water in the boilers, a rent occurred in the steam chimney of the starboard boiler. The steam and water rushed out of the boiler, and, melancholy to relate, scalded three of the passengers. Every attention was shown to the sufferers, who died before morning. Their names were John Connor, of Albany, William Farnham, of Greenbush, and Eli Bower, of Poughkeepsie; also two of the crew, Samuel M'Mullen and Rob. Steward, are missing, who, it is presumed, jumped overboard.—These are the only persons missing, as far as I can learn. There were upwards of three hundred persons on board, part of which went to Newburgh in the Experiment, and the remainder returned with the boat to New York. As there was no other boat out last evening there was no occasion for an extra head of steam. The injury to the steam chimney can be repaired in a short time, and she can take her place, and leave here on Monday afternoon for Albany at 5 o'clock.

MARTIN BARTHOLOMEW, Master."

"Captain Bartholomew, commander of the boat, testified that he left this city last evening, for Albany; when about thirty-six miles from this city, he heard an explosion which he immediately ascertained had been caused by the bursting of the steam chimney; this was about fifteen minutes after 8 o'clock, last evening; in consequence of the bursting of the chimney, the water was forced back through the return flues and out the door of the furnace.

The names of the deceased persons now on board, are John Connor, of Albany, aged 30 years; Wm. Farnum, of Greenbush, aged about 26 years, and Eli Brower, cloth manufacturer, of Poughkeepsie, aged 40 years. The first two named were lieing on the skylight which covers the cabin, exactly opposite to that part of the furnace through which the water rushed. Mr. Brower was standing near the same place. The boat was under a moderate press of steam, about fourteen inches; the boat often carries eighteen inches, and sometimes twenty, with perfect safety; they sometimes proceed with less steam than fourteen inches, when no more can be had; there was a sufficiency of water in the boiler, as one of the men who examined can testify; the chimney was iron, and was placed there new last season; the chimney is always expected to last as long as the boiler, which is about five years: the boiler was overhauled a short time since.

Two other persons besides those now on board dead, are lost; they were hands on board; their names were Samuel M'Mullen and Robert Stewart; they leaped overboard and were drowned before efficient aid could be rendered to them.

Peter Mathews, a fireman on board, testified that there was fifteen inches of steam on—he had just tried the quantity a minute before the accident occurred; the boat frequently carries seventeen inches, a quantity which is perfectly safe; does not recollect to have seen her carry twenty inches; has been in her about two years; the chimney was considered in good order.

Nathaniel Cornell, a hand on board, examined the water about five minutes before the accident occurred; there was then enough in the boiler; however, added some more, so that the accident could not have been caused by any insufficiency of water in the boiler; witness examined the chimney about two weeks since, it was then in good order.

Marcill Manning examined the chimney about a week since, it was then in good order; a patch was placed on one side of it about seven days before; it was not at the part repaired that the chimney burst, but much lower down, and on an opposite side.

Alexander Homestrum, the engineer, corroborated the testimony of the other witnesses as to the state of the steam and the water.

In addition to this testimony, the jury examined the bodies on board, and also the state of the chimney and boiler, and returned a verdict that the deceased persons had been scalded to death in consequence of the accidental bursting of the steam chimney on board the Ohio."

It is to be regretted that when disasters of this kind occur, inquiry is seldom instituted with a determination to ascertain the cause *any further than as it may implicate the captain, or the engineer and his attendants.* When no blame can be attached to them, the explosion seems to be looked upon as a mystery too dark to be scrutinized, and little or no effort is made to explore it. The rupture is repaired, and the boat runs again as before. Public excitement is transient, and the occurrence is soon forgotten except by the relatives and friends of the sufferers.

So long as this continues to be the case, there is no security that hundreds more of our citizens will not be hurried out of existence by steam-boat explosions. These awful occurrences cannot be prevented except by removing the causes of them. And how can they be removed, while these remain unknown?

That the primary cause of the present explosion was not known to the captain, may be inferred from the latter part of his letter, where he says "the steam chimney can be *repaired*, and the boat take her place on Monday;" and that it remains equally unknown to the owners and others concerned, would appear from their merely repairing the ruptured flue, (which they are doing,) without altering in the least its internal arrangement.

By referring to page 131, vol. ii. of the Journal of the Institute, the committee will find the origin of "steam chimnies;" but as no description sufficiently definite is there given of one, I have enclosed a sketch of that of the Ohio.[*]

Fig. 1

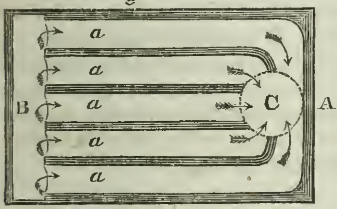


Fig. 1, is a plan of the flues and bottom of the boiler. A is the front end, at which the fuel is applied. The flame passes under the bottom to the other end, where it is received into the box or case B, which is open at its under side. The horizontal flues *a*, *a*, *a*, *a*, *a*, are connected with the case B; and their other ends lead into C, the main flue, which passes vertically through the boiler, (see fig. 2.) The dark parts in fig. 1 are spaces left between the sides of the boiler and the flues, and between each of the flues, and are occupied by water. The arrows show the direction of the flame.

Fig. 2

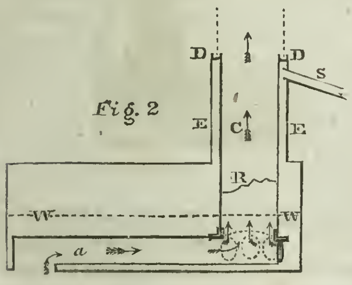


Fig. 2, is a longitudinal section of the boiler. C, is the ruptured flue, its upper part enclosed in another tube E, E, called a "*steam chimney*," attached to the top of the boiler, and forming part of it. A space is left all round C of $6\frac{3}{4}$ inches. E, E, and C, are united at D, D, and made steam tight.

The chimney proper is merely slipped on C at D, D, and held to its place by braces. At the upper end of E is inserted the steam pipe S, it projects three inches, (or about half way,) through E, as represented. It is eleven inches in diameter. The horizontal flues, five in number, are twenty inches in diameter. The vertical flue forty-two inches. From its junction with the horizontal flues, (only one of which is seen in this figure,) to its upper end at D, D, is eleven feet. The water line at W, W, is about ten inches above the horizontal flues, and the remainder of C, being ten feet of its length, is always uncovered by water. The rent took place at R, from fifteen to twenty inches above the water line.

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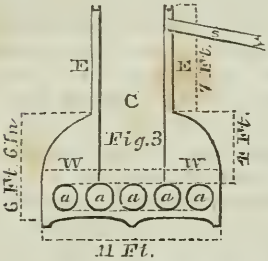
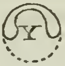
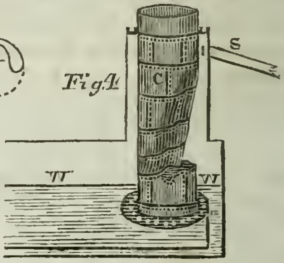
[*] In the course of conversation with an intelligent engineer who assisted me in obtaining information in relation to this explosion, he remarked that the rapid corrosion of the interior of iron boilers, might, in many cases, be attributed to the copper in the composition of the air pump, valves, feed pump, and pipes, &c. the water passing through them into the boiler having a *galvanic influence on the iron of the boiler*. In one case he observed that the part of an internal flue immediately opposite the mouth of a feeding pipe, and about four inches from it, was entirely eaten away, leaving a hole in the flue nine inches in diameter.

The line of fracture does not deviate more than six inches from a horizontal direction. It is partly along a row of rivets, but chiefly through the centre of the sheets. In one sheet the fracture exhibits the metal from one-fourth of an inch (its original thickness,) to one-eighth, and less than one-sixteenth.

The boiler is eighteen feet long, eleven feet wide, and six and a half feet deep, (see fig. 3,) its ends are flat. It is made of one-fourth inch wrought iron. Y, shows the form of the lower end of the collapsed flue; the circular part contained in dotted lines shows the original form of the flue, the irregular full lines show the form after the collapse. Fig. 4 represents it previous to its being taken out of the boiler; from the rent to the top of the collapse is six feet.







It will be perceived that the rent took place in that part of the main *flue* unprotected by water, and not in the steam chimney proper. This part of the flue is *always* exposed to the flame or heated air, and *never* covered by water.

Engineers consider it necessary to keep internal flues as well as those portions of the sides of boilers which are exposed to the fire, covered by water, as the only means of preventing them from rending; but in using steam chimneys, a method the *very reverse* is adopted. By them part of the flue above the water, is *necessarily* exposed, and this part embraces nearly *the whole* of the main internal flue, in which is accumulated all the heat and flame from the furnace that escapes through the horizontal flues.

In the Ohio, the part thus exposed is ten feet long and three and a half feet diameter, the whole of which is always uncovered by water, except what may be occasionally thrown up against it by ebullition.

The circumstance of this flue being in a perpendicular position can impart no additional security from the action of the fire, but rather the contrary, since the whole of its circumference is exposed to its influence. The only difference in its favour is that the greatest portion of heat from the furnace is probably taken up by the bottom of the boiler and the horizontal flues before entering it; and this is the supposition of those who advocate the use of steam chimnies. The heat, they further say, is "*exhausted*" before entering the vertical flue, and that without regard to the nature of the fuel used.

But if the heat were *exhausted* before entering the vertical flue, the steam chimney would be useless, as its design is to impart the extra heat of the fire chimney to the steam.

This heat is, however, far from being exhausted. The working cylinders of the Ohio are nearly forty feet distant from the steam chimnies, consequently the steam pipes are about the same length; and yet the packing of the pistons, and the hempen covering of the steam pipes, have frequently been charred.

The temperature of that portion of the horizontal flues near to where they unite with the vertical one, will be much the same as the lower part of the latter. If there be any difference, the vertical flue is probably the hottest, because the heat from all the others is there received by it, and the direction of the draft is suddenly changed at the same place: hence, if part of the horizontal flues are in danger of collapse when uncovered by water, the lower part, at least, of the vertical flue is equally so, and from the same cause.

But the appearance of the ruptured flue is a sufficient proof that the heat is not exhausted before entering it. It is fairly burnt out. In some places not even one-sixth of its thickness is left. The greater part of this flue was new about eighteen months ago, but the part rent has been in use a little more than two years.

When it is considered that the part rent was constantly liable to be made *red hot*, and probably was frequently so, we need not wonder that it collapsed under a pressure of fifteen pounds to the square inch. The greater wonder is, that it withstood it so long.

The same cause also accounts for the rapid destruction of its material. Indeed these flues are all rapidly worn out at the same place, and this is the testimony of an experienced manufacturer of steam engines. It is corroborated also by that of an intelligent engineer, who informed me lately that one of our largest and most splendid boats, had a new vertical flue last season, and yet a portion of it had to be replaced near the water line a few weeks ago, being no longer safe.

There is another circumstance attending the use of steam chimnies which still further promotes the destruction of the flue in question, viz. the large quantity of mud and other matters that float on the water is drawn against this flue (where it hardens and forms a crust) by the current of the steam in rushing up into the steam pipe at every stroke of the piston.

Fusible plates and valves have been designed to prevent the temperature of the steam from exceeding that of the water on which it reposes, but these devices are totally inapplicable to steam chimnies, since the very evil they are designed to prevent, is considered an advantage in the use of the latter.

The advantage of steam chimnies, it is said, is that "they rarify and still further expand the steam after it is generated;" but its expansive *force* cannot thereby be increased above that in the other parts of the boiler; for steam of different elastic power cannot exist in the same vessel at the same time. And whether they are of any advantage by depriving the steam of a portion of its moisture, previous to its entering the cylinder is at least doubtful, since it is one of its constituent principles, by depriving it of which, its density is proportionably diminished, and upon the density and temperature depend the expansive force of the steam.

The theoretical question of the effect of heating steam, after it is produced, in contact with the water which produced it, requires further elucidation. And after this should be determined we must consider the effect to be derived from transmitting this rarified steam through the pipes to the cylinder. But let us admit for steam chimnies all the advantages which have been claimed for them. Let us admit that their use economises heat which would otherwise be lost or less perfectly applied, and then let us answer the question, can these advantages make up for the increased dangers of explosions? can a paltry consideration of doubtful economy justify the exposure of human life incident to the use of a *heated flue uncovered by water?* The answer is plain, and the public are interested in making it heard.

Thos. Ewbank.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN APRIL, 1832.

With Remarks and Exemplifications, by the Editor.

1. For a machine for *Planing Boards*, *Cutting Tenons*, reducing marble, and other hard substances, and for grinding and polishing the same; Moses Lancaster, Northern Liberties, Philadelphia county, April 5.

(See specification.)

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2. For a machine for *Hulling Clover, Buckwheat and Bar-*

ley, and for scouring wheat; Thomas Register, West Township, Columbiana county, Ohio, April 5.

The specification informs us that in this machine there is a cylinder of free, or sand, stone, two feet in length, with an iron spindle through it turned by a crank; a concave of the same material, which is borne up against the cylinder, and a hopper for the grain or seed.

Not a word occurs respecting novelty, invention, or claim; we infer, therefore, from this, and from other circumstances, that there was no room to assert either.

3. For a machine for *Cleaning Clover Seed;* George Faber, Chambersburg, Franklin county, Pennsylvania, April 5.

(See specification.)

4. For an *Apple Grinding Machine;* Jonathan R. Dean, Augusta, Columbiana county, Ohio, April 5.

This is a very simple machine. A block of wood, formed like a grindstone, is to turn on an axis in the same manner; brads, or wires, are driven into it, standing out one-eighth of an inch, and a concave piece is to encompass one-third of this grinder, its lower edge standing close to the spikes; this concave is to be surmounted by a hopper, and there is to be a trough below to catch the pomace.

5. For an improvement in *Doors, by which the common threshold is superseded;* Eastman R. Ball, Oswego, Oswego county, New York, April 5.

The lower rail of the door is grooved to receive a strip, or valve, which when the door is shut is protruded downwards, and when it is open passes up into the groove.

The strip is held, and acted upon, by an angled lever, which stands in a mortice within the rail, above the groove and strip. A rod which is let into the rail, from the back edge of the door, is forced out by a spiral spring, and this raises the strip when the door is opened. When it is shut, this rod comes in contact with the rebate of the door frame, which, forcing it in, acts upon the lever and depresses the strip.

Contrivances very similar to this have been before made and patented.

6. For *Preparing Yarn and making it into Packing suitable to use about Steam Engines;* William V. Grinnels, Middletown, Middlesex county, Connecticut, April 5.

Yarn made of hemp is to be boiled in strong brine, and after allowing it to cool it is to be soaked for several days in ley, made of ashes and lime; after this it is to be dried, plaited, and worked up for use.

What good properties are communicated to the yarn by this process we are not informed; perhaps, however, it is intended to render it as incombustible as Salamander's wool, that it may resist those high degrees of heat which destroy the packing in engines of extremely high pressure.

7. For *Stocks for Gentlemen's wear;* Edmund Badger, city of Philadelphia, April 5.

(See specification.)

8. For an improvement in the *Machine used for Pegging Shoes and Boots;* Frederick Gray, Rowley, Essex county, Massachusetts, April 6.

The machine here patented for pegging boots, consists of an improved apparatus for holding the last firmly during the operation; to explain this contrivance clearly, would require a drawing, and we think but few will feel interest enough in the subject to regret the want of this appendage.

9. For *Seasoning Timber by means of Steam;* Abraham Plumb, Buffalo, Erie county, New York, April 6.

We are at a loss to imagine in what place the patentee can have lived that he should have arrived at manhood without hearing that the seasoning of timber by means of steam is a process well known and frequently practised. When we saw the title of the patent we concluded that some new apparatus, or mode of application, formed its basis; but we are simply told that the timber is to be put into a tight box, and to have steam from a boiler admitted to it through a pipe; and the claim is merely to "the application of steam to green lumber for the purpose of facilitating and hastening the seasoning, drying, and fitting it for use."

10. For a *Washing Machine;* David G. Wilson, Machias, Washington county, Maine, April 6.

A trough with a semicircular bottom, has a shaft crossing it, and carrying within it what the patentee calls moveable divers, that is, vibrating frames, formed of slats, which, being moved by a handle, squeeze the clothes to be washed against the grooved ends of the trough. This being nothing more than a trifling variation from preceding machines, we do not think it necessary even to insert the claim of the patentee.

11. For a *Spiral Flanched Shell, to be used as a substitute for the ordinary Bomb Shell, or Howitz;* William B. Pier and Andrew Mask, Detroit, Wayne county, Michigan Territory, April 6.

(See description among the specifications.)

12. For a *Machine for making Axes;* Josiah Pratt, jr., Claremont, Franklin county, Massachusetts, April 6.

This machinery consists of what the patentee denominates hammer and anvil dies; the first kind are to be worked like a trip hammer, the last, as the name indicates, forming the anvil, or bed. A particular description of the curvature of the faces of these dies, and of their size, is given in the specification.

The foundation of the axe from the bar of iron, is laid with one pair of dies, and another set is used for finishing. There is no claim made; reliance being placed on the entire novelty of the whole plan. "The manner of holding the iron under the dies, and the skill of moulding the axe," we are told, can be learnt only by observation and practice."

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13. For an improvement in the *Striking part of Clocks;* George Parker, Utica, Oneida county, New York, April 7.

Without a more lengthened description than, in our opinion, the alleged improvement calls for, we cannot make known the particulars in which the arrangement of the striking part, as described by the patentee, differs from that of the common clock; the object, we presume, is to construct it with somewhat less labour than that usually required, but the mode of accomplishing this is not clearly made known by the description and drawing.

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14. For an improvement in *Coaches, Barouches, and all kinds of Carriages;* Robert Gedney, city of New York, April 7.

The improvement described and claimed, consists in forming a moveable top, or cover, by which a barouche, or other open carriage, may, when desired, be converted into a close one.

The top may be made of wood, metal, leather, or any other suitable substance, and consists of two parts, each of which is a quadrant of a cylinder, working upon joints, or pins, in the centres of their curvature, on the side of the carriage. The body of the carriage must be made double, to form a cavity into which the covers which form the close top may fall; these cavities and tops are made much in the way with those of some circular fall writing desks. There are circular segments, or ratchets, to hold the tops in any required position; and in the ends, or peripheries, of the moveable tops, windows or blinds may be placed. The claim is to the "method of forming a moveable cover to barouches, and carriages of all kinds, by means of moveable segment covers turning on pivots, and shutting, or folding, within each other, so as to form an open, partly closed, or wholly closed, carriage."

If there is no objection to the perfectly circular, or cylindrical form which must be given to the body of the carriage, we do not know of any other that can be urged against this plan; we, however, are apprehensive that this form will not suit the large hats of the ladies, or admit of the desired perpendicular attitude in gentlemen above the middle stature.

15. For an improvement in the *Gun Lock;* Francis Dowler, Wayne, Knox county, Ohio, April 9.

The difference between this and the ordinary percussion lock consists in attaching to the usual lock plate nothing but the hammer lever by which the powder is to be exploded. The lever which acts upon the tail of the hammer, the main spring which bears against it, and all the other apparatus of the lock, are attached to the trigger plate, and are modified in their form accordingly. There is no claim made, nor do we perceive the slightest advantage to be derived from this particular construction.

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16. For machinery for *Jointing Staves* by means of a circular saw, and for *Sawing Bulging Staves* by means of a concave-convex circular saw; Philip Cornell, Brutus, Cayuga county, New York, April 11.

(See description among the specifications.)

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17. For a *Washing Machine;* Simeon Savage, East Machias, Washington county, Maine, April 11.

The washing in this machine is to be effected by passing the clothes between two wooden rollers, placed side by side across a trough, one of them being allowed to recede from the other whilst it is borne up against it by means of a weighted lever. In the operation of washing, a crank, attached to the gudgeon of one of the rollers, is turned with one hand, whilst with the other the clothes to be washed are conducted between the rollers; a sufficient quantity of soap suds being always kept in the trough.

The claim is to "the general arrangement of the machine herein described; that is, a machine with two horizontal rollers, one of which is borne against the other in the manner set forth."

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18. For machinery for *Cutting and Manufacturing Wooden Boxes;* Harrison Holland, Belchertown, Hampshire county, Massachusetts, April 13.

Wooden boxes are of so many kinds that the above title must fail in furnishing any definite idea of the intention of the machinery, nor does the petition, or the specification, supply the required information; we collect, however, from the drawing and the general description of the apparatus, that the boxes are to be round, and made out of solid stuff. An auger, running in the mandril of a lathe, is used to bore the boxes out, whilst cutters, placed at a proper distance from the auger, form the outside. A sliding carriage in front holds the timber, and this is brought up by proper contrivances against the auger and cutters. A circular saw, upon a sliding carriage, is used to cut the box off. The lids, it is said, may be formed on the same principle, but in this case the auger is to be shortened in due proportion. At the end of the specification we are told that "green timber will answer as well as that which is seasoned. This information is not calculated to throw much light upon the purposes for which the said boxes are to be made, as they will soon lose their rotundity if made of unseasoned stuff.

There is no claim made to the machinery as a whole, or in part, excepting that in speaking of the auger with which the boring is to be effected, it is said that it is "a screw auger, *without a centre;* this is claimed as a new invention, and may be applied,to other uses." The fact is, that the screw auger, without a centre, has been applied to other uses long since, and therefore it is not new. We have in our possession one of this description, which was patented so long since that the patent has run out.

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19. For an improved *Steam Valve*, called the "Face Plate Valve;" Stacy Costil, Philadelphia county, Pennsylvania, April 13.

The specification before us describes no particular construction of valve, but would apply perfectly well to a large proportion of those in general use. The patentee gives us no further information than that the valve consists of two plates with cavities, that it is made of iron or other metal, fitted so as to prevent the escape of fluids, except through the cavities, when they come opposite to each other; that there may be one or more cavities for the passage of the fluids; that the valve by a rotary motion may be used as a pump; (?) that the plates may be held together by a screw, or otherwise; that when the plates are in such a position that the cavities are not opposite to each other, the fluids are confined; and that the valve can be applied to cocks, &c.

The foregoing contains the whole sum and substance of the specification, and those who know any thing upon the subject will perceive that it would embrace in its generalizations, the various kinds of sliding valve, the old rotary valve of Oliver Evans, and a great number of others. What the patentee intended to patent, and thinks he has patented, we cannot divine.

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20. For a *Washing Machine;* Silvanus Minton, Anderson District, South Carolina, April 14.

This washing machine resembles the old fashioned cider mill, in the construction of the rollers which are to effect the washing. Two fluted rollers, each ten inches in diameter, are placed one over the other, with a suitable trough beneath them. The flutes, or teeth, mashing in like those of a cog wheel. The upper roller is borne down by weights, allowing it to recede from the lower one.

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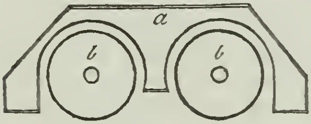
21. For *Apparatus to reduce the Friction in Axletrees;* Francis Reese, Habersham county, Georgia, April 14.

This apparatus to reduce friction consists of two rollers placed one behind the other on the lower side of each axle; they are to be three inches long, and one and a half inches in diameter, are to be let into mortices, and to revolve upon suitable gudgeons, their peripheries bearing within the boxes. The same thing, exactly, has been done before, and there is, therefore, no novelty in the contrivance; but a still less fortunate circumstance than this, is its entire want of utility. The gudgeons of the rollers are not adapted to bear the heavy weight which they have to sustain, and soon wear out. The rollers must bear against iron or steel within the hubs, or they immediately make a groove; the jolts to which they are subjected soon convert the rollers into polygons, and they cease to turn; besides all this, and much more, the weight cannot be made to rest on the rollers, were they calculated to sustain it, as the draft of the wagon will always cause the side of the axle to bear against the hub.

22. For a *Ruler for Counting Houses, &c.;* James Carrington, Wallingford, New Haven county, Connecticut, April 14.

This is intended as a substitute for the common round ruler, to which it is certainly much superior. It consists of a piece of mahogany, or other wood, made in the form shown at *a*, which is a transverse section of it. There are two grooves along the under side of it, to receive the two parallel rollers *b*, *b*, which extend its whole length, and revolve on pins running in metal plates at each end of the ruler.



The tendency of this ruler is always to run parallel; it does not readily slip like the common ruler; the bearing of the pen or plummet, is near to the paper, whilst the rollers keep the ruler sufficiently elevated to prevent all danger of blotting.

23. For a *Churn*, called the revolving Dasher Churn; Hardin Branch, city of New York, April 18.

Within a box, the bottom of which is made concave, there are revolving dashers, turned by a crank upon one of the gudgeons which passes through the end of the box.

The claim is to the before described churn.

We are of opinion that any one who will either make, or purchase such a churn from the patentee, or from any other person, may, with equal propriety, lay claim to the before described churn, without the necessity of placing the fact upon record in the patent office.

24. For a *Thrashing Machine;* Hardin Branch, city of New York, April 18.

The beaters of this thrashing machine are hinged to the cylinder, as has been repeatedly done. There is a hopper, or inclined plane, feeding rollers, a concave of bars, whirls, bands, &c., all of which are noticed in the description; after which a claim is made to "the before described machine." The concluding remark relating to the last noticed patent, will apply equally well in the present case.

25. For *Fastenings for Bedsteads;* Hardin Branch, city of New York, April 18.

A piece of cast iron, or other metal, is affixed to the end of the rail, and a corresponding piece on the post; the latter is in the form of a dovetailed wedge, and the former has a cavity within which it fits. The rail fastens on to the post by letting it drop down so that the cavities pass on to the wedge. One of the earliest of the various contrivances for dispensing with screws in fastening bedsteads, was of this character. In the present instance, however, the mode of attaching the fastenings to the rails and post is more simple, and proportionately less secure; this is the only *improvement* which we can discover in the thing. The claim is to "the before described method of fastening the posts and rails of bedsteads together by the dovetailed mortise and wedge, or tongue."

26. For a *Machine for Thrashing and Grinding Grain;* Matthew Wilson, Springfield, Rockbridge county, Virginia, April 18.

This is said to be an improvement in Samuel Cochran's wheat thrashing machine; but judging by the improvement alone, we apprehend that there are many other persons who may lay claim to the original. The claim to improvement is, in the first place, the gearing the horse power, by which the thrashing machine is to be driven so as to give it a quicker motion than ordinary. Secondly, the manner of applying a band from a drum around a pulley; this consists in giving the band two turns and crossing it, which the patentee says is "altogether new." The cast heads of the cylinder upon which the planking and beaters are fixed, and the secure method of putting them on are also claimed. By the same horse power which performs the thrashing, a small grist mill is to be driven; and the mode of gearing and manner of working this, form another claim.

If the claim to gearing so as to give greater speed than ordinary, is one which can be sustained, every additional cog added to a driving wheel, and every leaf subtracted from a pinion, may be the subject of a patent. We should demur to the novelty of crossing a band, and passing it twice round a whirl, and indeed to most of the points upon which the patentee has rested his right as an original inventor.

27. For *Door Fasteners;* Calvin Washburn, Bridgewater, Plymouth county, Massachusetts, April 18.

This is a spring door catch, operated on by handles in the usual way, but with some peculiarity in the arrangement of the parts which may be called new, and upon which the claim rests. We are not aware, however, that it is superior to some others, and shall therefore dismiss it, as, without a drawing, its peculiarity could not be easily described.

28. For an improvement in the *Mode of drawing Soda and other Mineral Waters;* George H. Duffey, Alexandria, Alexandria county, Virginia, April 19.

We have given an account of five different patents, each having the same object in view with the present; that is, to draw off by one cock the liquor from two separate vessels, one of which contains an acid solution, and the other a solution of carbonate of soda. The patentee in the present case says that this invention "consists in making the divisions and openings in the tube of the key so that liquids may be conveyed down each division separately, and not unite till they meet in the glass or vessel for receiving them, whereas the method lately patented, and now in use for drawing soda water by means of a compound cock, is to suffer the two liquors to unite in the cock, whereby the stronger liquor is forced up the tube of the weaker, and the whole spoiled."

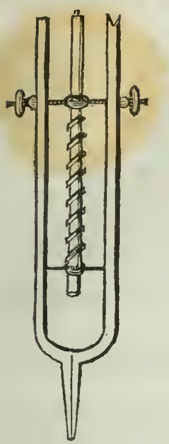
We are not certain, and do not think it necessary to ascertain, whether in all the five patents previously obtained, the mixture of the liquids takes place before it actually leaves the cock, or not, although we believe this to be the case, but we do not believe that the evil above stated, namely, that the stronger liquor is forced up the tube, &c., necessarily, or generally, exists—by the by, which is the stronger and which the weaker liquor of the two named, we really do not know—where, from the height of the fluids, there is a moderate pressure, this pressure combined with the ready exit which they find from the cock, would prevent such an effect. Some of the former patentees claim the drawing off of two fluids by one cock, and either this claim is worthless, or the present interferes with it.

29. For a *Churn,* called the "balance lever churn;" Caleb Argevine, city of New York, April 19.

This churn is two churns, each of which has its dasher and staff. A lever is made to vibrate like a scale beam, and has a dasher staff attached to each of its ends, the churns being firmly fixed on a platform beneath them. A band wheel, turned by a winch, gives motion to a whirl, on the shaft of which there is a crank, and a pitman from this crank causes the lever to vibrate. What the patentee "particularly" claims "is the equalizing power and combined advantages of the driving wheel, fly wheel, crank, and horizontal pitman, in giving motion to two churns in one operation."

30. For a *Centre Point Spring Bit;* Daniel Flint, Nobleborough, Lincoln county, Maine, April 19.

This bit may be likened, in form, to a tuning fork, the handle of which would represent the shank, and the forked ends the cutting



points. One of these points is notched, so as to cut a double groove, and the opposite point is chisel shaped, to cut out the stuff between the two grooves. The bit may be fixed in a lathe, or stock. To gauge it to the exact size required, a thumb screw passes through the two forks, and by means of this the points may be drawn together. The inside edges of the cutting ends may be so formed as to give a taper, or beviled entering to the plug which is to be cut out by it. There is also a centre piece, which being borne up by a spiral spring, recedes as the points advance.

The principal intention of the bit is to manufacture plugs for ships, although it is applicable to other purposes, such as making bungs for barrels, &c.

31. For a *Cutting Box for Straw, Stalks, &c.;* Jacob Harland, Tompkinsville, Monroe county, Kentucky, April 19.

A winch, which is to be turned by hand, has on its shaft a fly wheel and crank. The crank gives motion to the cutting knife, which is fixed in a frame, working up and down at the front end of the box, like a saw frame. The feeding is effected by a rack, and the parts, generally, operate upon the same principle with a number of other straw cutters. There are certain claims made, but they refer to trivial points, and not to any thing essential to such a machine.

32. For apparatus or machinery for *Holding and Guiding Edge Tools in the operation of Grinding;* George A. Madeira, Chambersburg, Franklin county, Pennsylvania, April 19.

(See specification.)

33. For *Protecting Bank Notes, &c.* from being counterfeited; Francis Peabody, and Joseph Dixon, Salem, Essex county, Massachusetts, April 20.

The object had in view by the patentees is to prevent the counterfeiting of bank notes by means of lithography. Those acquainted with that art are aware that the impression upon a bank note, or other engraving, printed with ink into which oil enters as a component part, may be transferred on to stone, and the stone then used to furnish similar impressions on paper. According to recent accounts from Europe the utmost perfection has been attained in this process, which, as it is merely mechanical, may enable one who is no artist to imitate the work of the best engravers in a way which shall defy detection.

The means by which the patentees effect their object is by taking printers' ink, or ink made from oil, which is to be of a pink, light blue, or other tint, and which will serve as a ground for the black ink generally used in printing bank notes. The paper intended to be printed on is first covered wholly, or in part, with the light coloured oleagenous ink, and after this the notes are printed with black ink in the usual way. Any attempt to make a lithographic transfer from paper so prepared must fail altogether, as every part which has either the tinted or the black ink on it, will affect the stone, and only a confused, blurred impression, can be obtained from it.

The claim is to the preparing of paper in the manner described.

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34. For a *Washing Machine;* Benton P. Coston, city of Philadelphia, April 27.

The soap suds and the clothes to be washed are put into a suitable trough, and within this trough is a fluted washboard; a fluted roller, borne down by springs, is made to vibrate over the board by proper contrivances, of which we have as little inclination to give a description, as most of our subscribers would have to read it if given.

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35. For an *Engine for Turning Whip Sticks,* or Handles; Andrew Mallory, Russel, Hampden county, Massachusetts, April 27.

This engine is intended to be used in turning whip handles tapering, either regularly or otherwise, and it may also be employed for helves, or other sticks, whether cylindrical or tapering. The stick to be turned may be fixed in the mandril of a common turning lathe, and the apparatus here patented placed in front of it. It consists, in part, of a frame with parallel sides, equal in length to the length of the stick to be turned. A piece carrying a cutter, which operates as a gouge and chisel, slides along in grooves on these sides. This sliding part consists of two bars hinged together at one end, and capable of being opened or closed at the other; and near to this latter end is fixed the cutter before spoken of. The stick to be turned rests on a hollow bearing of metal on the lower piece, and the cutter passes through the upper piece. It is evident that if these two parts, which form the hinged sliding bar, recede from each other as the bar advances, the article operated upon by the cutter will have a corresponding increase in its diameter. To effect this, each of the bars has a tongue on it which slides in a groove on one of the cheeks of the frame. There are, of course, two grooves, and if these were parallel to each other, the two parts of the sliding bar would keep at the same distance apart, and the article turned would be cylindrical; but if the grooves recede, the bars will be gradually separated, and the article will be tapered.

The whole machine is claimed as new, and not as an improvement on any other for the same purpose previously known.

36. For an improvement in the *Plough;* John B. Norton, Utica, Oneida county, New York, April 27.

This is to be a self-sharpening plough, and the description amounts, altogether, to but five lines. The improvement is said to consist in a recess on the back of the mould board, and a projection on the flanch to fill this recess, which is to be sufficiently wide to prevent the flanch from tipping, or changing its position on the mould board; it is intended, likewise, to prevent the flanch from shifting when the pattern is being moulded. The foregoing description is somewhat obscure; we have the drawing before us, but there is in this also so much taken for granted, that we have not sufficient imagination to fill up the chasms, and may in consequence, suffer great loss.

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37. For *Obtaining Opium from the Poppy,* by expression; Lucius Cook, Shrewsbury, Monmouth county, New Jersey, April 27.

We have here a specification still more brief than the last, being merely informed in it that opium is to be expressed from the poppy by a press of any kind; a screw press, like that of an oil mill, being preferred.

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38. For *Applying Copal or other Varnish* to Whip stocks, or other articles, by dipping; Frederick Morgan, Westfield, Hampden county, Massachusetts, April 27.

The articles to be operated on are to be dipped into a tube filled with the varnish, which, it is said, is a superior method to the use of a brush. This is the whole recipe, and we are very apprehensive that there are but few persons in the habit of using varnish who have not occasionally resorted to the same mode; we have repeatedly done it, although not with whip stocks, and we may probably do it again, with "other articles," the patent before us to the contrary notwithstanding.

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39. For a *Floating Screw Dock;* Stephen F. Stinchfield, New Orleans, Louisiana, April 27.

The floats which in this contrivance are to answer the purpose of wharves in the ordinary screw dock, are formed by two boats, or flats, securely framed and planked. Screws, with their proper nuts, are sustained upon these floats, and are of sufficient length to reach down to the cradle beams over which the vessel is to be floated, and upon which there are the necessary keel blocks, bilge blocks, and other appurtenances. The claim is to "the before described floating screw dock, for raising vessels, or for floating them over sand bars, or when run aground."

The screw dock has been previously patented, and is extensively used; and as it is intended to employ this floating dock for the purpose of repairing vessels, we apprehend that the claim of the patentee will not be available, for although he uses floats instead of wharves upon which to sustain his screws, these still operate in the same way with those alluded to.

We are at a loss to perceive how, on the plan we are now considering, the cradle beams are to be passed under a vessel which is aground; there may possibly be instances in which this can be done, but we think they must be very rare.

40. For a machine to *Prepare Card Boards* to receive the handle and the card; Homer Whittemore, Newtown, Queen's county, New York, April 27.

The card board is to have two dovetailing kerfs sawed into it by means of a circular saw, in the usual manner. It is then placed upon a machine which holds it firmly, and a chisel, fixed in a sliding frame, is brought up by a crank, and cuts out the chip, which there is also a contrivance to remove. The handle is then driven in to its place, and the projecting part of it planed off by revolving planes, attached to the mandril of a turning lathe.

41. For a *Lever Power Machine for Propelling Mills,* and which may be applied to boats, water craft, rail-road carriages, &c.; William Rhodes, Trenton, Gibson county, Tennessee, April 27.

This is another of those miserable schemes for gaining power which can deceive those only who are totally ignorant of the principles of mechanics, a class, however, which, unfortunately, appears in every community to be a very large one.

A crank placed on the end of a vertical shaft is to be turned by horse, or other power; at the lower end of this shaft is a large horizontal crown wheel, the teeth of which drive a wallower; and from the shaft of the wallower rises a pitman, which alternately elevates and depresses two long levers of the second kind. Palls, or catches, descend from these levers, and engage into ratchet wheels on a horizontal shaft, there being two such wheels, one for the catch of each lever. The levers, as they rise, drag round the shaft of the ratchet wheels, and from this, the power, *created* by the described arrangement, is to be communicated and employed for any required purpose.

42. For a *Rotary Toggle Joint Press;* Thomas W. Harvey, Jamestown, Chautauqua county, New York, April 27.

Without a drawing we shall not attempt a description of this press, particularly as we expect, at an early day, to publish the specification, with an engraving. We will merely observe that what is usually called the toggle joint is not employed in it, the two levers which operate upon this principle not being connected together, although they are brought into contact with each other by the revolution of two parallel shafts from which they project. The machine is about being put into operation in New York, and should it answer the anticipated purpose, it may be applied to the cutting of various articles; to stamping impressions from dies, and for a great variety of other objects.

43. For a machine for *Planing, Tonguing, and Grooving Boards;* John Drummond, Whitestown, Oneida county, New York, April 27.

Two pulleys, of about eighteen inches in diameter, and which run vertically, are placed at such distance from each other as shall correspond with the length of the stuff to be planed. Planes are attached to a strap, or band, which passes round these pulleys, and the plane stocks are supported by ways, on which pins, or a tongue, projecting from it, bear, as the straps and planes revolve. The board to be planed is placed upon a horizontal bed, or bench, so situated that the faces of the planes shall pass over it. The planes, as they pass round, strike against a spring catch intended to shift the board under them, laterally, at every stroke.

The claim is to " the before described machine for planing boards; particularly the way, with semicircular ends, the belt and pulleys by which the plane, or planes, are moved and governed; and the moveable parts for giving proper thickness to the boards."

We are of opinion that this machine has never been tried in practice, as we believe that after doing so the inventor would have declined taking a patent for it; the objections to it appear to us to be numerous and insuperable.

44. For a *Wind and Water Wheel;* Adkins Nash, Addison, Washington county, Maine, April 27.

This is a wheel with wings, or buckets, hinged, or suspended by pins, upon which they turn, in order to their being presented edgewise, or flatwise, to the fluid which is to act upon them.

The floats, or wings, are to be made concave on one side and convex on the other; the wheel, when used for wind, is to be placed vertically, and a very complex apparatus of ropes and blocks is employed to give to the wings, or sails, a proper direction; four pulleys being used to each wing. There is an endless screw and a cog wheel employed to turn a barrel, over which pass numerous ropes that are reeved through the pulley blocks in a way which we do not think it worth while to describe. When operated upon by water the floats are to regulate themselves.

45. For a *Process for Flattening Window Glass;* John J. Adams, city of Washington, District of Columbia, April 27.

The apparatus here patented is intended for flattening cylinder window glass. It consists of a circular oven, or flattening furnace, having in it a circular rail-way of cast iron, upon which the flattening apparatus can be made to revolve. The cylinder is to be put in through the stick hole, and, as it is acted upon by the fuel, is carried round until it arrives opposite to one of the flattening mouths, where it is flattened out upon a stone in the usual manner. By further turning, it is carried round until it arrives at what is called the cooling arch. This is an arch of about thirty feet in length, and three in width; within it two endless chains pass over rollers which cross it at suitable distances, for sustaining the chains. Upon these chains are keyed plates of sheet iron, about three by two and a half feet, upon one of which the flattened plate is laid from the flattening apparatus; the endless chain is then carried forward by turning a winch until another sheet of iron presents itself to receive another plate of glass; the plates are thus gradually carried along the cooling arch, until they are ready to be delivered from the far end.

The plan of the cooling arch is similar to that of the annealing ovens at the flint glass works, and would undoubtedly answer the intended purpose; we have not equal confidence in the annealing furnace, and the apparatus within it. Without the aid of actual experiment it is not possible to say that the fire can be so managed as to afford the exact degree of heat which is requisite, or that the revolving rail-way would not be attended by unanticipated difficulties in the course of its operation.

46. For an improvement in the *Grist Mill;* Amos Barnes, Colesville, Broom county, New York, April 27.

It is said that by this improvement the power required for driving the mill is lessened, the motion of the stone regulated, the friction reduced, and even grinding promoted. The stones are to be about two feet in diameter, and the upper one, the runner, is to be covered with a casing of cast iron, in order to give it weight; the eye of the stone is to be wider on the lower than on the upper side, and above the drum, or pulley, there is to be a balance wheel by which the mill is to be driven; there are to be several other contrivances which, however, are so similar to what we have had repeated occasions to describe, that we omit further notice of them. A number of things are claimed, some of which, as that of weighting the stone, the form of the eye, &c. &c. are old; if, however, the mill performs better than any other, as the patentee says it does, that at least will be something new.

47. For a *Reaction Water Wheel for Mills;* John Moffit, Richmond, Ross county, Ohio, April 27.

This is very much like the common tub wheel, but there are some provisions made respecting its structure which we do not fully understand.

The wheel, we are told, is to be made of eight solid blocks, and is to run horizontally upon the lower end of a shaft, which is to be a hollow cylinder in order to prevent the too great weight of water upon the wheel. This cylinder is to be surrounded by another, and between these the water is to descend to the openings which surround, and are near to, the periphery of the wheel. There are to be eight of these perforations passing obliquely from the upper to the lower surface, at an angle of forty-five degrees. The improvements principally relied on, are the delivery of the water at the bottom instead of the side of the wheel, and the double cylinder for its descent.

We perceive no advantage, whilst there is a real disadvantage in delivering the water at the bottom, instead of at the sides; the point of delivery of a large portion of the water must be considerably nearer to the centre of motion on the former, than on the latter plan; and besides this, the delivery at the bottom is not itself new.

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48. For a *Machine for Spinning Wool and Cotton;* David Newbrough, Riley Township, Butler county, Ohio, April 27.

A spinning wheel, instead of turning one only, gives motion to six, or more, spindles, by suitable bands. The carded rolls are placed in troughs or gutters opposite to the spindles, and there are the requisite contrivances for winding the yarn upon the spindles after it has been spun. There, however, is nothing worth a particular description, as the whole apparatus is similar to a number of other domestic spinners patented a few years since, but which have gone out of fashion since the extensive introduction of machinery into our manufactories.

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49. For a machine for *Hulling Clover Seed;* George Monohon, Augusta, Columbiana county, Ohio, April 27.

A trough is made which is to be eight feet long, two feet wide, and one foot high. The bottom of this trough is concave lengthwise, to a radius of twenty feet, and is fluted across in flutes of half an inch wide. Within this, is fitted a convex rubber which may be about half the length of the trough, and is furnished with handles, for the purpose of working it backward and forward.

After describing this contrivance, the patentee adds that he also claims the right to any machine made of wood in the form of mill stones, whether placed horizontally or perpendicularly, enclosed within a hoop, or otherwise, guttered, or reeded, and whether moved by horse, or man, power. The description of the actual machine did not certainly prepare us for such a claim to machinery which bears scarcely any analogy with it; and which indeed seems to us to be a little like claiming all rubbing machines, past, present, and to come.

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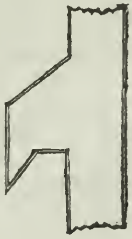
50. For an improvement in the *Saw Mill;* John R. Drake, Owego, Tioga county, New York, April 27.

The saw frame and fender-posts of this machine, are constructed in the usual way, the main difference in it being in the form of the teeth of the saw. In a saw of six, or six and a half feet in length, there are to be about twenty teeth, the cutting points of which are to project downwards like a "duck's bill chisel." The form intended will be seen by the sketch in the margin. Guide pieces are to be fastened



to the fender posts, through notches in which the saw is to work, and it is thus to receive a lateral support; the claim is to the peculiar form of the teeth, and to the guides.

The latter have been frequently used, and the former, we apprehend, will not often be adopted. For most kinds of timber, the cutting such teeth, will be too rank; but, independently of this, a saw so formed will last but little time, as, in the process of sharpening, the teeth will not merely retire back, but will actually disappear. Teeth made in the usual manner can be so sharpened as to cut upon the proposed "duck's bill" principle, by merely filing them hooking underneath, and taking off the point nearly straight, on the front edge of the saw.

51. For an improvement in the *Turning Lathe;* William Green, Bedford county, Tennessee, April 27.

The inventor says that this lathe has a carriage moved by iron cogs, to work the gouges, and an oblique and nipped bit for smoothing and centring cylinders; the gouges, &c. being tempered by screws.

Whatever merit may be attributed to this lathe in the part of the country where the patentee resides, he would, in other parts of the Union, find it to be a very rude kind of instrument. He may have invented the whole as described by him, but, were he well acquainted with the lathes now in use, he would acknowledge his own to be a very indifferent make-shift.

52. For apparatus for *Preventing Chimneys from Smoking;* Jeremiah Sullivan, Washington city, District of Columbia, April 27.

Jambs, a top plate and back, are to be made much in the usual form of the Franklin stoves; the upper section of the back plate is hinged, so that it may be opened, or closed, at pleasure, to alter the size of the throat. In addition to this, there are to be sliding dampers to draw out and regulate the draft in the flue. In these consist the alleged *invention*, although such contrivances are well known and extensively used. We have had repeated occasions for making similar remarks, the latest will be found at p. 163, where it will be seen that a similar apparatus was patented on the 17th of March last.

There is not any thing said in the form of a claim, and, of course, the whole arrangement described is viewed by the patentee as new.

53. For a *Cotton Press;* David Philips, Natchez, Mississippi, April 27.

There is some novelty in the construction of this press, more, in fact, than is exhibited by a majority of those patented for the same purpose. The packing is effected by means of a screw which is placed vertically, operating upon followers in a box placed horizontally, and the machine may be so constructed as to pack two bales at once.

Two strong beams, thirty-four feet in length, and two feet in width, are to be laid horizontally; these are connected together by end pieces framed into them, which end pieces are equal in length to that of the bale to be formed. This frame, when enclosed below and above with proper doors, forms the boxes into which the cotton is to be forced by the followers. From the middle of this frame rise two vertical cheeks between which the screw is sustained; this screw may be twelve or fourteen feet in length, and extends down below the horizontal box where the power is applied to turn it. The nut through which it passes slides between the cheeks, and is raised and lowered by turning the screw, which does not itself ascend or descend, but merely moves the nut. Now we will suppose the nut raised between the cheeks to the upper part of the screw, and the followers to be withdrawn from the horizontal boxes in which the cotton is to be packed; in this state of things the doors are to be opened, the boxes filled with cotton, and the doors then closed, when the operation of pressing commences. In order to cause the nut, as it is drawn down, to act upon the follower, strong pieces of timber are hinged to it by one end, and by the other to the followers; and when the nut is up, these timbers may stand at an angle of forty-five degrees with the frame; as they are drawn down they approach towards a horizontal position, and when completely down are actually horizontal. The two acting together operate like the toggle joint which is straightened by the screw, thus forcing in the followers upon the cotton.

The usual provision is, of course, made in the boxes to receive the bagging and ropes for baling the cotton, which needs no explanation as it is common to cotton presses of every description.

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54. For *Making Barrels, and other vessels, so tight as to hold Oil* of various descriptions; Barnabas Springer, Henry county, Indiana, April 27.

After the barrel, or other vessel, has been put together, the hoops are to be loosened, and the joints allowed to open, when glue is to be passed into all the joints, and the hoops tightened. The joints in the heads are to be previously secured in the same way. Would not gum water, or other mucilage, answer equally well, and be more easily managed?

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55. For a machine for *Moulding and Pressing Bricks;* Daniel Bomford, Deerfield, Oneida county, New York, April 28.

Of this machine there is a long description given, which ends by claiming "the before described machine for moulding and pressing bricks;" the said machine, however, is very obscurely described as relates to some of its important working parts; and although we doubt not that, in point of arrangement, it presents sufficient novelty, there is but little of it in its individual parts, or in the mode of its operation.

The clay, after being properly prepared, is put into a hopper, under which there is a carriage running horizontally, it being moved by means of a rack and pinion; the moulds are to be placed upon this carriage, and run under the hoppers; a presser, or follower, within the hopper, is then brought down, which carries a portion of the clay before it into the moulds; after this the moulds are run out, and the operation repeated.

56. For *Preparing Luminous Glasses to be used in Orreries, Planetariums, &c.;* Morris J. Gardner, York, York county, Pennsylvania, April 30.

Globular, or other glasses, which are to represent planets or satellites, are to have a sufficient portion of phosphoric oil poured into them to moisten their inner surfaces. A small opening is to be left for a supply of air to excite the luminous appearance; this constitutes the whole invention, which is one of those that will, probably, not be carried into operation by any one except the inventor himself; at all events we are fully convinced that he will not make a fortune by his discovery. We could suggest what we deem much better modes of accomplishing the end proposed, but are apprehensive that even they would rarely, if ever, be essayed, and we are no admirers of abortions.

57. For a mode of *Bleaching Yellow Wax;* John N. Shultze, chemist, city of New York, April 30.

(See description.)

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a patent for machinery for Planing Boards, Dressing Marble, and other substances, and for Sawing Tenons. Granted to MOSES LANCASTER, *city of Philadelphia, April* 5, 1832.

To all whom it may concern, be it known, that I, Moses Lancaster, of the Northern Liberties, in the county of Philadelphia, have invented an improved machine, which may be used for planing boards, and reducing marble, and other kinds of stone, metallic, and other substances, to a flat surface; and in which circular saws are also employed for the slitting of tenons, and other purposes, and that the following is a full and exact description thereof.

For the planing of boards I construct a wheel which is made to revolve vertically upon a horizontal shaft by any suitable power. Or instead of a wheel, two, four, or any other number of arms may project from said shaft, and carry such irons, cutters, grinders, and polishers, as are intended to be fixed upon the wheel. The diameter of the wheel must be more than double the width of the article to be cut, planed, ground or polished. Cutters, made in the manner of plane irons, are employed for planing, their cutting edges being on one face of the wheel, and they being set and secured in their places by wedges, or otherwise.

I do not, in general, make the face of the wheel where the cutters operate, of a continued flat surface, but near to its periphery I turn it down, or otherwise reduce it so that it shall form two, three, or more parallel planes, each one-fourth of an inch, more or less, below the other. Each of these faces may be furnished with cutters; that nearest the rim taking the place of the ordinary jack plane, and the others in succession further reducing and smoothing the substance.

When stone, or other hard material, is to be cut, the cutters must be so formed as to adapt them to the intended purpose. When substances are to be ground, or polished, pieces of grinding or of polishing stone, or other suitable materials, occupy the place of the cutters upon the face of the wheel.

A carriage, or sliding frame, is made to run in grooves, near to the face of the wheel, and to pass above its axle, the frame work of the machinery being so constructed as to sustain and guide said carriage horizontally; it must be of such length and width as to receive the board, or other article to be operated upon by the wheel. Against this, such article is to be placed, its edge resting on proper ledges or supports, and the whole being held against the carriage by clamps, screws, or other contrivances.

The wheel is made adjustible on its gudgeons, so that it may adapt itself to the thickness of the article to be cut or ground.

For cutting tenons, I fix two or more circular saws upon the same shaft, regulating their distance from each other by disks of wood or of metal placed between them. The shaft carrying these saws is placed horizontally in the same frame with, and parallel to, that carrying the cutter wheel. The rails, or other stuff upon which tenons are to be sawed, are to be secured upon the sliding carriage before mentioned, with the end to be cut downwards, so that when the carriage is forced forward the revolving saws shall cut into it the proper depth for the tenon.

The saw shaft may be shifted endwise, like that of the cutter wheel, to adapt it to its purpose.

What I claim as my invention is the vertical wheel, constructed in the manner described, with cutters upon successive faces, retiring from each other, or with grinders or polishers applied in the manner and for the purposes hereinbefore set forth, and also the employment of circular saws for cutting tenons, operating in the way described in the foregoing specification.

MOSES LANCASTER.

Specification of a patent for a Machine for Cleaning Clover Seed. Granted to GEORGE FABER, *Chambersburg, Franklin county, Pennsylvania, April* 5, 1832.

To all whom it may concern, be it known, that I, George Faber, of Chambersburgh, in the state of Pennsylvania, have invented an improvement in the machine employed for the cleaning of clover seed, and that the following is a full and exact description thereof.

In my machine, the clover to be cleaned is made to pass between cylinders and concaves, as in many others constructed for a similar purpose; but my cylinders and concaves are set with teeth in a manner altogether different from that of such as have been heretofore made. I prepare wire cards by setting card teeth in leather in the usual manner, but of coarser wire, and with the rows between the teeth wider than ordinary. The wire, for example, may be about No. 17 or 18, and it is to be so set as to leave clear parallel spaces between the rows of teeth, which spaces may be an eighth of an inch or more in width. These cards are to be fixed upon the cylinders, with the teeth and spaces forming lines passing directly around, and parallel with their ends; and also in the hollow of the concaves in the same way.

When the cylinder and concave are fixed in the frame within which the former is to revolve, the teeth of the cylinder pass in the spaces between those on the concave; the two being placed so near to each other that the points of the revolving teeth come nearly in contact with the leather on the concave, and the teeth on the concave nearly touch the leather on the cylinder, whilst the teeth themselves run clear of each other, that is, those on the cylinder do not touch those on the concave.

The cylinder is made to revolve in such way that the teeth on it and those on the concave have no tendency to catch, their points being inclined in a direction opposite to that of the revolution.

I generally make the concave to embrace one half of the cylinder, or nearly so, but this is not a point of great importance. I commonly use two or more cylinders and concaves, placed below each other, so that the seed may be successively acted upon by the whole of them. The best arrangement I believe to be the employment of two cylinders with their concaves, such as I have described, and a third, not set with card teeth, but with its surface made rough, so that it may act as a rubber. This cylinder may be made of sheet iron punched from the inside in the way well known, or it may be formed of any other substance, or be covered with any article producing the same effect. Such cylinders having been frequently made, I do not claim them as making any part of my invention; I, however, have devised a new mode of constructing the concave in which such a cylinder may run; which concave, or apron, I form of leather, skin, cloth, or any similar material; this concave, or apron, I cause to pass around a portion of the cylinder, sustaining it by its ends upon suitable strips, or rods, to keep it in its place, without any other support. The part of such leather, or other material which reacts against the roller, may also be covered with any hard or gritty substance.

After the seed has passed the rollers covered with cards, and as it falls from them to the rubbing roller, I sometimes subject it to the action of the fan, operating with sufficient force to drive off a large portion of the chaff without blowing away the seed.

There are to be a feeding hopper, a crank for turning the machine, and the requisite whirls and bands, which do not require description.

What I claim as my invention is the manner in which the wire cards are made and fixed on the cylinders and concaves, as hereinbefore set forth. I do not claim the using of wire cards for the purpose of cleaning clover seed, they having been before so employed, but not operating upon the principle or in the manner in which they are used by me.

I also claim the application of the elastic apron, or concave, to a rubbing cylinder, in the manner, and for the purpose herein explained. The other parts of the machine which I have described, I do not claim.

GEORGE FABER.

Specification of a patent for Stocks for Gentlemen's wear. Granted to EDMUND BADGER, *city of Philadelphia, April* 5, 1832.

To all whom it may concern, be it known, that I, Edmund Badger, of the city of Philadelphia, have invented an improved mode of manufacturing stocks for gentlemen's wear, and that the following is a full and exact description of my said improvement.

I take hog's bristles, and weave them into a webbing, of linen, cotton, silk, or other suitable material; and from this webbing I cut my stocks into the proper form. I then bend them over a mould, or block, to give to them the intended form. Whilst on the block I stiffen them with shellac, or other varnish, after which they are finished by trimming in the usual manner.

What I claim as my invention, and for which I ask a patent, is the weaving of hog's bristles as a filling for webbing to form stocks for gentlemen's wear.

EDMUND BADGER.

Patent for an improvement in the Science of Gunnery, which may be used as a substitute for the ordinary Bomb Shell, or Howitzer; and which may also be substituted for the ordinary cannon shot or musket ball, and ejected from guns of any size or calibre. Granted to WILLIAM B. PIER *and* ANDREW MARK, *city of Detroit, Wayne county, Michigan Territory, April* 6, 1832.

The patentees denominate their invention an "elongated spiral flanched shell," and an "elongated spiral flanched shot." The first is named from its peculiar form, and is to be cast of such size as shall adapt it to the ordinance from which it is to be projected. For the sake of ready description, a shell adapted to a three pounder is taken as an example. Its form, without the flanches, is that of an elongated egg, with the small end truncated, or cut square off. The length of the shell may vary from one and a half to two or more diameters of the bore of the piece from which it is to be fired. The reason of varying the length is to allow of a larger cavity in certain cases, where it may be required. When the cavity is large, and the shell consequently thin, it is elongated in order to give to it the necessary weight. The large, or forward end, which nearly fits the calibre of the piece, is a solid hemisphere of metal, the weight of which will insure its keeping the proper direction when fired from the piece.

Wings, or flanches, are cast upon the outside; of these there may be four, or more, they extend from the small end of the shell, to the swell of its hemispherical end; their direction is oblique, as they are designed to give to it a rotary motion like that of a rifle ball. Those edges of them which strike the air, are at right angles to the body of the shell, and they extend out therefrom, so that their exterior edges shall every where fit the bore. The angle which they make with a longitudinal section of the shell may vary from five to twenty degrees, more or less, as may be found best to answer the object intended. The diameter of the small or after end, may be reduced to one-third or one-half of that of the bulb or larger end, and the flanches, therefore, widen out in proportion. To charge the cavity of the shell, an opening is left either in the small end, or in the side between the flanches, through which the charge is to be introduced, and the opening then stopped with a screw, or a plug of wood or metal.

The shell is to be made to explode by means of percussion power. For this purpose a hole is to be drilled through the larger end, or bulb, of the shell, in the direction of its axis. This hole may be from one-fourth to three-eighths of an inch in diameter until it reaches near to the cavity, when it is to be continued of such size only as may serve for a touch hole. An iron or steel bolt, surrounded by leather, or other elastic substance, is put over the percussion powder, and extends out from the front of the shell; its exterior end widens out like a nail or bolt head. This striking against any hard substance, occasions the contents of the shell to explode.

The "elongated flanched shot" is similar in its external form to the shell, but as it is to be used as a shot merely, it has no cavity. When used for small arms it is to be cast of lead, to give it sufficient weight. The patentees say that its flight will be more rapid and its range greater than that of a round ball.

Patent for machinery for Jointing Staves with a circular saw; and for Sawing Bilging Staves, by means of concavo-convex circular saws. Granted to Philip Cornell, *Brutus, Cayuga county, New York, April,* 1832.

For a full explanation of the particular construction of this machinery drawings would be required, a general idea of its construction may, however, be given without them.

The jointing apparatus is intended for such staves as are straight upon their edges. The staves are held down upon a carriage by means of a lever, the adjustable bed of the carriage having such an inclination as that rake shall give to the edges of the staves which shall correspond with the size of the vessel to be formed; in this state the carriage is made to advance, carrying the staves against the edge of a circular saw. Several staves, placed one upon the other, are jointed at the same time. There is nothing new in the principle of this part of the machinery, the patent, therefore, is taken for the particular arrangement by which the operation is effected.

For sawing barrel, or other bilging staves, a concavo-convex saw is made, which is a section of a sphere of such radius as shall adapt it to the bilge or curvature of the staves to be sawed by it. The staves are sawed one out of the other, either from plank or rived timber, of such thickness as the width of the stave may require. The carriage upon which the stuff to be sawed is fixed, has curved ribs, or guide pieces, taking into corresponding grooves in the bed upon which it runs, the radius of their curvature corresponding, of course, with that of the saw used.

The carriage is driven forward by means of an endless screw, a rack and pinion, or other suitable contrivance.

Sometimes an apparatus is used which joints the stave, giving the proper curvature and rake to the edges, at the same time that it is cut by the concavo-convex saw. This apparatus consists of two circular saws running on separate axes, and contained each in a sliding frame, governed by grooved guide pieces in such a way that as the stave advances against them they joint it in the manner described. We believe, however, that the machinery is rendered too complex by this addition, and that the patentee prefers to perform the operations separately. The patentee says:

"What I claim as new in the before described machinery, and for which I ask a patent, is the apparatus for jointing straight staves several at a time, one edge only, by means of a circular saw, and giving to them the proper bevel, as herein set forth. I also claim the sawing of bilging staves by means of a circular concavo-convex saw, whether the same be done by using a carriage upon the construction set forth in this specification, or by placing the saw itself upon a moving carriage. For although I have described and represented certain frame work, and modes of communicating motion, I lay no claim to this particular arrangement of the accessory parts of the machinery."

Specification of a patent for an apparatus for Holding and Guiding Edge Tools in the operation of Grinding. Granted to George A. Madeira, *Chambersburg, Franklin county, Pennsylvania, April* 19, 1832.

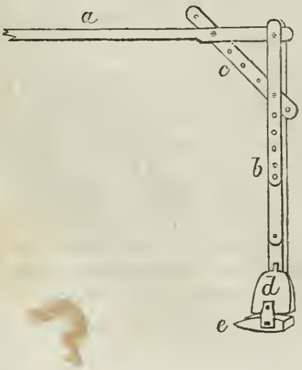
To all whom it may concern, be it known, that I, George A. Madeira, of Chambersburg, Franklin county, Pennsylvania, have invented an apparatus, or machinery, for holding and guiding edge tools, and other articles in the operation of grinding, which apparatus greatly facilitates the said operation, and will enable an inexperienced hand to perform it with precision; and that the following is a full and exact description of the said apparatus.

I use a spring pole, which is fixed along or near to the ceiling of the room or workshop, in the manner of those used for the pole lathe. The elastic end of this pole is directly over the grindstone, and from it descends a part which I denominate the hanger; the hanger is hinged or jointed to the spring pole, so that the angle which they make with each other may be varied. A brace passes diagonally from the spring pole to the hanger, a mortise being made through each for that purpose. This brace may be lengthened or shortened by means of pins, which pass through holes in it, and in the spring pole and hanger, and serve to confine them in any required position.

In order to adapt the hanger to articles of different sizes and kinds, it is made capable of being lengthened or shortened; this may be effected by dividing it and making one part to lap over the other, or by a long slot in one piece, and a corresponding tongue on the other, with equidistant holes through them, and pins or screws to adjust or confine them.

To admit of the article which is to be ground being moved backward and forward on the stone, there is a hinge, or rule joint, near the lower end of the hanger; and to allow of its transverse motion, the block upon the under side of which the article is to be held, is attached to the hanger by a hinge, or rule joint, in the reverse direction.

The block must vary in its form and construction according to the nature and form of the article to be ground; and the articles may be held in their places by means of screws, wedges, or otherwise. No particular directions can be given for this part, nor is it necessary, as every workman can readily adapt the block to the particular purpose which it is required to answer. The block is sometimes made with a handle projecting from each side of it, one for each hand. When axes, or other articles with eyes in them, are to be ground, the handle may pass through the eye, and form one part of the arrangement by which it is attached to the block.



I have thus described the manner in which I ordinarily form this apparatus; it, however, is susceptible of various modifications, whilst the general principle of its structure and action remains unchanged. I do not, therefore, claim the exact and particular formation thereof as herein set forth, but what I claim as my invention, and for which I ask a patent, is the use of a spring pole, with a descending part, which I have called the hanger, and a piece at the bottom thereof, similar to what I have denominated the block, to receive and hold the article to be ground; the apparatus being furnished with joints to admit of motion in two directions, and being adjustible in its length, to suit different articles.

GEORGE A. MADEIRA.

Patent for an improvement in the mode of Bleaching Yellow Bees-wax. Granted to JOHN N. SHULTZE, *Chemist, city of New York, April* 30, 1832.

Four vats are to be prepared which may each be about four feet long, three wide, and three deep; these are to be placed side by side, to facilitate their use. They may be numbered 1, 2, 3 and 4. Into No. 1, 200 lbs. oxymuriate [chloride] of lime, and 125 gallons of water are to be put; the mixture is to be well stirred, and the impurities allowed to settle. 500 lbs. of yellow wax are to be put into No. 2, and heat applied, either by steam or otherwise, sufficient to melt the wax, which is allowed to remain at rest, that its impurities may settle. The clear melted wax, and portions of the solution of oxymuriate of lime, are to be laded into vat No. 3, heat being applied to keep the wax melted, which, however, is not to exceed 160°. Nearly all the solution of oxymuriate will in general be used in this first process, which, however, will in general but partially bleach the wax. The mixture is to be constantly stirred for about an hour, in which time this first operation will be completed. A mixture, consisting of twenty pounds of sulphuric acid, diluted with thirty of water, is then added, and agitation kept up for half an hour. The acid, combining with the lime, sinks it to the bottom, and leaves the bleached wax floating above it; this settling is effected in about half an hour. The process has sometimes to be repeated a second or third time, depending upon the portion of colouring matter in the wax.

When the wax has been thus sufficiently bleached, it is put into vat No. 4, and as it still contains some water, this is to be separated from it. To effect this, thirty pounds of common salt are added, which being soluble in, unites with, the water, and the weight of this solution causes it to separate from, and descend below, the wax, which thus acquires a clear and transparent appearance.

To improve the white appearance of the wax, an ounce of pulverized Antwerp blue, previously mixed with a quart of the melted wax, is poured into vat No. 4, when the whole is deposited in proper vessels.

ENGLISH PATENTS.

Specification of the patent granted to George Forrester, *Civil Engineer, for certain improvements in Wheels for Carriages and Machinery, which improvements are applicable to other purposes. Dated September* 5, 1831.

To all to whom these presents shall come, &c. &c. —*Now know ye*, that in compliance with the said proviso, I, the said George Forrester, do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, are described and ascertained in and by the following description thereof, reference being had to the drawing hereunto annexed, (that is to say)—

My invention consists in a peculiar mode of combining cast iron with wrought or malleable iron in the construction of wheels of all descriptions, (excepting those of such small dimensions as the wheels of clocks and watches,) and in the application of the same principle of construction to the framing for steam engines and machinery, the arches of bridges, and in every case in which cast iron framing may be employed, and wherein great strength and lightness are desiderata.

My mode of accomplishing the aforesaid combination is as follows: I make a skeleton, or light frame, of wrought iron, or steel, of the shape of the article required, but of considerably less dimensions; this skeleton I render bright, free from oxide, and clean, by any convenient operation, such as grinding, scouring, and filing, to adapt it to receive a coating of lead, or bismuth, or tin, or zinc, or any mixture of those metals, such coating being performed by similar means to that used in the well known process called "tinning." The article to be cast having been moulded in sand (or loam) in the common way, the skeleton, coated as before mentioned, is carefully laid in the middle of the respective parts of the mould, projecting pieces being attached to the skeleton to keep it in its proper place; the mould is now to be closed, and the cavities formed by the pattern are to be filled up with fluid cast iron, which completes the operation.

By this mode of embodying or enveloping wrought iron or steel skeletons of the shape of the intended article, with cast iron, the latter material is not injured in its tenacity, while the former is considerably improved, and thus the important qualities of toughness and infrangibility are introduced into forms more perfect, and structures more solid than can be obtained in wrought iron alone. To prevent misconception, I annex a drawing illustrative of the construction of one of the leading objects of my invention, that of wheels for rail-way carriages, and which will also serve satisfactorily to explain the mode of applying the principle of construction to the purposes before named.

Description of the drawing.

Fig. 1 exhibits a side view of the wrought iron or skeleton framing before described.

Fig. 2 shows an edge or outside view of the peripheral ring of the skeleton, showing its proportional breadth, and containing a number of holes made throughout its circumference, for the purpose of allowing the fluid iron, in casting, to flow through the holes, and fix itself in a solid mass around the skeleton.

Fig. 1.

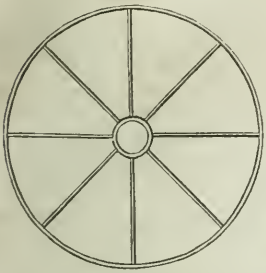


Fig. 5.

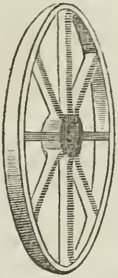


Fig. 3.

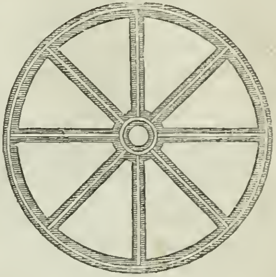


Fig 2

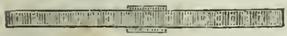


Fig 4.

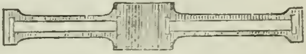


Fig. 3 represents a section of the wheel in the line of its motion, the blank line showing the skeleton embodied in the cast iron.

Fig. 4 shows a section of the wheel through its diameter, including two of the spokes; and fig. 5 affords a perspective view of the entire wheel. [*Rep. Pat. Inv.*

ANALYSIS OF THE REPORT, &C. ON STEAM CARRIAGES.

Report on Steam Carriages by a Committee of the House of Commons of Great Britain. With the minutes of Evidence, and Appendix. Reprinted by order of the House of Representatives of the United States. (1832.)

(Continued from p. 180.)

We apprehend that the minutes of the evidence before the committee will prove of more interest than the report itself.

The witnesses examined in relation to the progress, &c. of this branch of locomotion, were Messrs. Goldsworthy Gurney, Walter Hancock, Richard Trevithick, Nathaniel Ogle, Alexander Gordon, Joseph Gibbs, William Altoft Summers, and James Stone, who as inventors and patentees of different steam coaches, or as connected with them, must be considered in the light of interested witnesses; John Farey, Thomas Telford, Thomas M'Adam, and John Macneil, well known as civil engineers, Davies Gilbert, ex-president of the Royal Society and member of the committee on steam carriages, and Col. Torrens, a member of the same committee, having no other than a general interest in the progress of the invention.

From the testimony of Messrs M'Adam and Macneil, we shall derive useful information in relation to the turnpike roads of England,

and to the effects produced upon them by various agents. The remarks will be found less applicable than could be wished to roads in our own country, similar only in name to most of those spoken of.

We proceed with a condensed view of the more interesting parts of the evidence, quoting when the importance of the subject, or the method of handling it, requires such a course.

Mr. Gurney states that in his first attempts to propel coaches by steam, he used a propeller, or leg, projecting from behind the coach, that subsequently having found the adhesion of the two hind wheels sufficient, the propeller was only applied in ascending hills; that the adhesion proving sufficient in this case also, even with one wheel, the propeller was entirely laid aside. To prevent slipping, the steam is let very gradually upon the piston, ("wire-drawn.") He states several hills which his coach ascended, (Highgate hill, Stanmore hill, &c.) but does not give their elevations. These experiments were made in 1826.*

In 1827 further experiments were made which showed the practicability of using the steam coach to drag a second coach after it. A trip was made in one trial (load not stated) in which the carriage went 84 miles in ten hours, including stoppages. The weight of the steam carriage was, in this stage of its improvement, reduced from four tons, to thirty-five cwt. One of the coaches actually running between Gloucester and Cheltenham, is certified to weigh nearly three tons: this was not built by Mr. Gurney, though upon his plan. The hind wheels of Mr. Gurney's coach are five feet in diameter, the fore wheels one foot less. It is proposed to use smaller wheels when power, and not speed, is required. The tires of the wheels are three and a half inches wide, those of a common stage coach being about two inches. This carriage is upon springs, it is calculated (weight thirty-five tons,) to do the work of about three and a half horses.

Mr. Gurney calculates that three and a half bushels of coke and seventy gallons of water, are a charge for a stage of about seven miles when the roads are bad, requiring about half this quantity when they are good. The wear of the roads by this carriage is stated to be the same as that of ordinary carriages, estimating by the relative wear of the tires of the wheels of the two kinds of coaches.

The fuel used being coke, there is no smoke, and the escape steam is conducted into a peculiarly constructed chamber, so as to prevent noise. Horses sometimes start at the unusual appearance of the carriage; there should be in a well constructed engine no noise to alarm them.

From a clay rut of eight inches deep, the carriage was propelled by attaching a second wheel; up hills the friction of two wheels was frequently necessary. The stroke of the piston in the engine of this carriage is about eighteen inches. The pressure of steam used seventy pounds. The boiler tubes from half an inch to two inches in diameter, their thickness about the eighth of an inch, they are proved to about 800 lbs.

The carriage can be stopped within a few (six or seven) yards, by reversing the communication of the steam with the piston. Both carriages, when moving slowly, may be readily turned, the inner circle being about ten feet in diameter. The only accident which Mr. Gurney himself had met with in experimenting, was in the carriage moving too rapidly down hill (from carelessness in neglecting to lock the wheel,) and becoming unmanageable.

These carriages may be moved more economically upon paved roads, but on ordinary turnpikes they will answer. Not more than one-fourth of the power required upon a gravelled road is expended in moving over a pavement.

Mr. Gurney proposes that a toll should be exacted in proportion to the ratio of weight of a carriage, and to the average weight of a horse, which he fixes at ten cwt. He is of opinion that the hoofs of a horse would injure a road much more than the same weight upon wheels. At a rate below four miles an hour a greater expense would be incurred by moving a burthen by steam than by horses; above four miles an hour, the economy is in favour of steam, the gain increasing with the speed.

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* Those of Evans, it will be recollected, were made in 1804.—Reviewer.

Mr. Gurney has run at the rate of from eighteen to twenty miles an hour; there was no sort of difficulty in guiding the carriage when moving at the rate of twelve miles an hour.

From certain calculations, the details of which are submitted to the committee, Mr. Gurney concludes that steam-stage coaches may be run at about one-fifth the cost of the common coaches. The items are, first cost, wear and tear, and keeping. The details, if accurate in England, would be inapplicable here.

Mr. Gurney values a horse power at nine gallons (average) of water evaporated in one hour, under either high or low pressure. The rapidity of motion of a carriage, by enabling it more readily to overcome obstacles, is favourable to economy, so that a piston moving at the rate of fifty feet per minute will require more fuel to do a given work than if travelling at the rate of two hundred feet per minute.

Charcoal is sometimes used as fuel in the steam carriage, but more usually coke; there would be great economy in using coal, but the smoke would prove an annoyance on the road. Mr. Gurney asserts to have made experiments on a large scale, in which he found that smoke could not be completely consumed by any draught; he supposes the particles of carbon to be so surrounded by carbonic acid as to prevent combustion, requiring this gas to be removed before smoke can, by a supply of air, be entirely consumed.

In relation to the explosion of boilers, Mr. Gurney is of opinion that they are produced by some new and at present unascertained compound of hydrogen, oxygen, and nitrogen.

The explosive compound is supposed to be formed at high temperatures, and to come in contact with substances capable of decomposing it, when an explosion is produced.

This idea is supported by a reference to certain opinions of Gay Lussac, that there *may be* compounds of hydrogen and oxygen yet undiscovered; a very philosophic admission from which Mr. Gurney draws, in a strange manner, authority for this new compound. He asserts that there is but one compound of hydrogen and oxygen acknowledged in England, though two are admitted by French chemists; any elementary work would have corrected such an idea, and would also have shown him what are the "certain substances" by contact with which the deutoxide of hydrogen may produce explosive effects.

Mr. Gurney gives an account of the explosion of a cauldron in a brewery, which he advances to prove his hypothesis, suddenly leaving it when we suppose him about to draw the conclusion. He reasons thus; before the open cauldron exploded, a gelatinous matter had formed and prevented the contact of the water with the bottom of the cauldron, which thus became heated, and the compound was formed: now we expect the compound to explode, instead of which "the rupture of this film, and the sudden contact of water against the hot surface below, produced such an immense and sudden volume of steam that it burst the boiler." Exactly as the rupture of a film of dirt, or of carbonate or sulphate of lime would have done.

Mr. Gurney uses fusible plates to prevent the undue heating of the parts of his boiler, and a glass gauge to indicate the level of the water within, besides the usual stop cocks. His indicator of the pressure of steam is a weighted piston.

On ordinary roads it would not be reasonable to expect a steam carriage to draw more than its own weight. On ice the wheels require roughing; in deep snow the progress is very difficult; when ice is below the snow it becomessoon compacted, and the carriage passes forward readily.

Mr. Gurney goes into an examination of the benefits which would be derived from the substitution of steam power for horse power; the argument is true every where, but derives its force from the peculiar condition of England. We quote at length.

"I would state generally, in regard to the main improvements on steam engines, by which this country has been so much benefitted, and the prospects of advantages arising from steam carriages, that they have almost always been in a direct ratio with that of removing of horses; that the great and splendid improvements of Mr. Watt have generally been supposed to be principally connected with the separate condenser of the steam engine, and the saving of the fuel; but before Mr. Watt's day, we could empty our mines of water in Cornwall, and we could do a variety of other simple work by the steam engine, and so far the improvement of Mr. Watt was simply with respect to the saving of fuel; but I consider that the great national advantage arising from Mr. Watt's improvement, has been his application of the steam engine to machinery; and the extent of that advantage to the community has been in a direct proportion to the removal of horse power, a most unproductive labourer, and a dead expense to the country. If this view of the subject be entertained, the application of steam to propelling carriages on common roads, will be as important above its application to machinery generally, as the number of horses employed in locomotion exceeds that necessary to machinery, which bears no proportion with respect to each other. At Hounslow alone, there are at this moment upwards of 1,000 horses employed in stage coaches and posting. On the Paddington road, a distance of five miles only, there are upwards of 1,000 horses employed at this moment. Throughout Great Britain it is almost impossible to say how many horses are employed, but I should perhaps be within bounds if I were to say millions, in posting and stage coaches. If it is possible to remove those horses by an elementary power, which I firmly believe is practicable, the national advantage must be in proportion to the number of horses so removed; for if it is shown that one carriage horse can be removed from the road by the present state of steam carriages, I see no reason why every horse so employed should not be so removed. It has been decided that the consumption of a horse is equal to that necessary for eight individuals, so for every horse that is removed and is supplied by elementary power, we make way for the maintenance of eight individuals. If it is possible to carry the idea so far, and I see no objection to it, to do the principal work of horses by steam, or if it can be done by elementary power, the committee may imagine to what extent we may provide for our increasing population. I think we may do much by political laws and enactments, but natural laws will do more, and when pointed out by the finger of Providence, may be made to provide for his wise dispensations. I firmly believe that the introduction of steam carriages will do more than any other thing for this country. I have always had this impression; I left an honourable and lucrative profession, in which I was extensively engaged, in order to attend to this subject, because I was convinced of its importance and practicability; I have always entertained the same idea as I do at present. Imperfections will exist in the machinery; but I conceive that the main points of difficulty have been removed by the experiments I have made, and that all those now remaining are practical difficulties, which will be removed by further experience; and if there is no cause opposed by the Legislature, or any other source, I will be bold to say, that, in five years, steam carriages will be generally employed throughout England. I have not hesitated, having these feelings, to devote all my time for the last six years to the subject, and am mentally recompensed by the present state of the subject. Private carriages also will be used. Under this opinion I have given directions for building a small one. I expect it will go quicker, safer, more easily, and certainly more independently than a common carriage, because it does not need the food of a horse."

To provide against accident in case the guide of the steam carriage should fall asleep, or be thrown from his place, Mr. Gurney has contrived to cause the steam valves to remain in gear only while the foot of the guide presses upon the apparatus. The same contrivance applies to moving down hill.

The next witness examined was Walter Hancock, also engaged in projects for locomotion.

Mr. Hancock states that he has been running his coach about twelve months, the stage is four miles, water being supplied at every eight miles. The quantity of water required for the eight miles is stated to be seven cwt. and of coke two bushels, or one-fourth of a bushel per mile. When the roads are good, the engine is worked at about seventy pounds per square inch upon the safety valve. The boiler used is Hancock's chamber boiler, and is thus described.

"There are flat chambers which are placed side by side, the chambers being about two inches thick, and there is a space between each two inches; there are ten chambers, and there are ten flues, and under the flues there is six square feet of fire, which is the dimension of the boiler top and bottom. The chambers are filled from half full to two-thirds with water, and the other third is left for steam: there is a communication quite through the series of chambers top and bottom; this communication is formed by means of two large bolts, which screw all the chambers together; the bottom bolts, the bottom part of the chambers, and the top bolts, the top part of the chambers; and by releasing those bolts at any time at all, the chambers fall apart, and by screwing them they are all made tight again. We have braces to fasten them; the steam is driven out from the centre of one of the flues, and the water is ejected from the pump at the bottom communication for the supply of water."

The iron of this boiler was an eighth of an inch thick.

In a carriage weighing 35 cwt. Mr. Gurney required 700 lbs. of water to go seven miles, and three and a half bushels of coke. Pressure about 70 pounds to the square inch. Mr. Hancock's carriage weighing from sixty to seventy cwt. consumes 784 lbs. of water in eight miles, (686 lbs. per seven miles,) and requires two bushels of coke (one and three-fourths bushels for 686 lbs.) to convert it into steam. Pressure as above. The economy would appear greatly in favour of Mr. Hancock's boiler (as .57 to 1,) if the number of either patentee can be relied on as more than a rude approximation.

In Mr. Hancock's carriage the passengers are in the front part of the coach, and the engine is between them and the boiler, which is placed behind. The guide is in front. The carriage weighs about seventy cwt., and carries ten passengers. Breadth of the tires about three and a half inches. Diameter of hind wheels four feet, but should be five.

Every part of the engine is upon springs. The power is communicated by two cranks, one attached to the piston of each cylinder. The cylinders are nine inches in diameter, and the piston has twelve inches stroke. The carriage is sixteen feet long. The steam when escaping is thrown into the fire to prevent unpleasant noise, which is calculated, beside, to alarm horses on the road.

Mr. Hancock gives an instance of the bursting of one of the chambers of his boiler without noise or danger, and supposes them very safe, since steam is not allowed to accumulate in them, but is removed as fast as produced.

The carriage may be turned in an inner circle of four feet, and outer of ten feet radius. Mr. Hancock thinks that by reversing the motion of the engine he could stop, when going at the rate of eight miles an hour, in about twelve feet, or even in four feet.

A system of tolls is thought best which shall charge stage coaches in proportion to their weight, or to the number of passengers which they can carry.

In overcoming a hill, which is mentioned, the difficulty of forcing the coach up in frosty weather, by the adhesion of a single wheel, is spoken of. When the roads are neither very wet nor very dry, the travelling is the most unfavourable.

Mr. Hancock thinks that the fare could be reduced to two-thirds of that asked by the stage coaches, and that 100 miles could be accomplished in ten hours, including two hours of stoppages.

The evidence of Mr. Farey we propose to give somewhat in detail; as an engineer his name is well known, and having no share as a patentee, nor any direct interest, in the various projects, his evidence may be regarded as professional in its character, and without any special bias. Hence his remarks upon locomotion in general, upon the relative advantages of the different plans, upon the manner in which it may be helped forward by the government, &c. are of special interest. His evidence is less interrupted by queries, and the information better put together than those of the patentees.

"Have you turned your attention to the subject of propelling stage coaches or other carriages, by steam power on common roads, instead of by horses? I have had occasion to prepare specifications of several such inventions for which patents have been taken out, and have, in consequence, paid a close attention to that subject. I have also been consulted to settle the plans for the practical execution of steam coaches, but I have not directed or superintended any such execution myself. Of the specifications I have prepared, three have been followed up by building coaches, which have actually travelled on common roads; viz. Mr. Gurney's, Mr. Hancock's, and Messrs. Heaton's. I believe those three are the only trials, amongst many others, which have had so much success as to have been persisted in to the present time. I have examined other steam coaches, but they had no chance of success, and have been abandoned.

"Will you state, generally, your opinion as to the probability of this mode of propelling carriages superseding the necessity of using horses? All that has been hitherto done, or which is now doing, in that way, must, I think, be considered as experimental trials. I have no doubt whatever but that a steady perseverance in such trials will lead to the general adoption of steam coaches, and that, at an earlier or later period, according to the activity and intelligence with which an experimental course is conducted; and I am firmly convinced that the perfection which is essential to their successful adoption will never be attained by any other course than that of reiterated trials. The difficulties with which the steam coach inventors are at present contending, are chiefly of a practical nature, which I think, are not likely to be avoided by any great efforts of genius or invention; but I expect that they may be surmounted one after another by the experience which may be gained by competent mechanicians in a course of practice. I do not look for much more invention as necessary to the establishment of steam coaches; but it is certain that the practice is indispensable.

Each of the three inventors I have named has brought his steam coach to that state which renders it a full sized model for making such experiments as serve to prove the principle of action, and to teach how a better coach may be made the next time, but nothing more. The probability that such next better coach will be sufficiently perfect to answer as a trading business, depends as much upon the natural judgment and acquired skill of each inventor, as upon the qualifications of his present production."

"Has the experience which has already been had of steam carriages been such as to enable us to say that it is not merely in theory we have calculated on these carriages? Yes: what has been done by the above mentioned inventors, proves to my satisfaction the practicability of impelling stage coaches by steam on good common roads, in tolerably level parts of the country, without horses, at a speed of eight or ten miles an hour. The steam coaches I have tried, have made very good progress along the road, but have been very deficient in strength, and consequently in permanency of keeping in repair, also in accommodation for passengers and for luggage; for which reasons they are none of them models to proceed upon to build coaches as a matter of business. From the complexity of their structures, and the multiplicity of pieces of which they are composed, it is impracticable to give them the requisite strength by mere addition of materials, because they would then be too heavy to carry profitable loads as stage coaches. I do not consider that it is now a question of theory, for the practicability I conceive to be proved; but many details of execution, which are necessary to a successful practice, are yet in a very imperfect state. My view of the subject will be best understood by stating, that I believe an efficient steam carriage might now be made merely to carry despatches, by following the general plan of the best steam coach which has yet been produced, improving the proportions wherever experience has shown them to be faulty, using the very best workmanship and materials, and giving a judicious increase of strength to the various parts which require it, allowing all the weight of a load of passengers and luggage, and of the accommodations for them, in additional strength of materials, so that the total weight of the coach, without any passengers or goods (beyond the people and stores necessary for its own use and one courier,) should be as much as the weight of the previous model containing a full load of passengers and luggage. If three such coaches were constructed, one of them might start every morning at each end of any fair line of road 100 or 120 miles long, and one would arrive every evening at each end of that line in less time than a common stage coach; and I should expect that, after twelve months' perseverance, and after making all the improvements and alterations in the machinery which so much experience would suggest, the double passage ought to be made with as much safety and punctuality, and with much more expedition, than by the mail. The road between London and Bristol might be taken as a suitable line, but I should expect a pair of horses to be provided at every notable hill, to help the steam carriage up it. Such a proposition, it is obvious, offers no inducement to individuals, because it would be all expense without any return; but if it were judiciously done at public expense, I have no doubt but that it would lead to as much improvement in the mode of execution of future coaches as would enable them to be run permanently as stage coaches with profitable loads. The great defect of all the present models, is want of strength to resist the violence to which they are subjected in rapid travelling with a full load; and if that strength were given upon the present construction by the mere addition of materials, they would become too heavy to be efficiently propelled, even if they carried no load in them."

"As far as your experience has gone, which plan of steam carriage do you think will hereafter be most generally resorted to, that of an engine carriage drawing after it another carriage containing the passengers, or of conveying the passengers in the carriage in which the machinery is placed? I have not had experience in drawing by two carriages, except by the analogy of what is done on rail-ways, and hence I feel some difficulty in speaking positively upon that point. There are advantages and disadvantages to be considered in both modes, but all the mechanical considerations incline to one side, viz. to place the engines in the same carriage with the passengers. That plan will certainly be lighter than when two separate carriages are used, and also the weight will be laid on those wheels which are turned by the engines, as it should be, to give them a firmer adherence to the road; also one carriage will steer and turn much better than two, and will go safer down hill, and will be cheaper to build and to work."

"By that means great weight is saved? Yes; perhaps one-third is saved in exerting an equal power. In stating my opinion of the probability of a profitable result, after twelve months' trial of three coaches to run regularly two hundred miles every day, with despatches only, I contemplated that the engines and passengers would be, ultimately, in one carriage, because that plan has a most decided mechanical advantage in making progress along the road, and also in facility of steerage, and safety in going down hill, and fewer servants are required to manage one carriage than two. On the other hand, all the constructions that have yet been tried with one carriage, subject the passengers to more or less occasional annoyance from heat and noise, smoke and dust, and there is still an apprehension of danger from the boiler: hence passengers will invariably prefer to go in a separate carriage to be drawn by the engine carriage; that mode also offers a facility of changing the engine for another, or for post horses, in case it gets deranged, because the change may be made without unloading, and discomposing the passengers. For common stage coaches these are strong motives to use a separate carriage, and if it can be brought to bear in comparison with horses, that mode will probably be most generally adopted by the influence of the passengers, although the other mode will inevitably perform the best and attain the greatest speed of travelling."

"Taking the two machines of Mr. Gurney and Mr. Hancock in their present state, do you think them entirely free from defects likely to prove dangerous to travellers? I do not think the danger is at all considerable in either Mr. Gurney's or Mr. Hancock's: there are dangers in all travelling; but I do not think the amount of danger will be at all increased by substituting steam for horses, according to either of those plans."

"The question refers to the peculiar danger from the nature of the propelling power? I am not inclined to think that there is any peculiar danger which would be incurred by the change; and if the engines and passengers are not on the same carriage, I think the ordinary danger would, on the whole, be diminished."

"The question is with reference to the relative danger of travelling ten miles an hour when drawn by horses, and when propelled by steam at the same rate? The danger of being run away with and overturned is greatly diminished in a steam coach. It is very difficult to control four such horses as can draw a heavy stage coach ten miles an hour in case they are frightened, or choose to run away, and for such quick travelling they must be kept in that state of courage that they are always inclined for running away, particularly down hills, and at sharp turns in the road. The steam power has very little corresponding danger, being perfectly controllable, and capable of exerting its power in reverse, to retard in going down hill; it must be carelessness that would occasion the overturning of a steam carriage, which carries the passengers in the same carriage with the engines. The distinct carriage I consider to be much less controllable in turning corners and going down hill, but yet far more so than horses. The chance of breaking down has hitherto been considerable, but it will not be more than usual in stage coaches when the work is truly proportioned and properly executed. The risk of explosion of the boilers is the only new cause of danger, and that I consider not equivalent to the danger from the horses. There have been, for several years past, a number of locomotive engines in constant use on rail-ways, all of them having large high pressure boilers, very much more dangerous than Mr. Gurney's or Mr. Hancock's, whether we consider the probability of explosion, or the consequence likely to follow an explosion, because, being of large diameters, they are less capable of sustaining the internal pressure of the steam; and, also, they contain a large stock of confined steam and hot water. The instances of explosion among those locomotive engines have been very rare indeed."

"Have you seen Mr. Hancock's last improvement? Yes; I consider Mr. Hancock's boiler to be much better for steam coaches than any other which has been proposed, or tried."

"If that boiler were to explode, it is understood that there would be no danger at all? It is very difficult to foresee that; at the same time, the risk of explosion in Mr. Hancock's boiler is certainly very much less than in the locomotive boilers which are in constant use on a large scale on rail-ways, and where we have proof that the extent of the danger is very small."

"Do you think his boiler might explode without the passengers knowing any thing about it? The metal plates of which the boiler is composed will burn through by the continuance of the action of the fire, and may crack or open so as to let the steam or water out of the boiler and disable the coach from proceeding, but that is hardly to be called an explosion; no one would be hurt. The crack which lets out the hot water is sure in that case, to throw it into the fire and not on the passengers."

"You consider the danger to passengers by the chance of bursting of a boiler as not equivalent to the danger of horses running away? It is not equivalent, in my opinion; the probability of a coach being overturned by the horses is far greater than that of a boiler bursting, and when either accident does occur, the probable extent of mischief from an overturn in which all the passengers must participate, is much greater than could be expected from the bursting of a boiler, which must always be kept at a considerable distance from the passengers on account of the heat."

"Supposing either Mr. Hancock's or Mr. Gurney's boiler were to burst; in the one case the boiler being in a separate carriage, and in the other, the boiler being at considerable distance behind the passengers, what danger do you think could arise to the passengers from the bursting of the boiler? There is very little difference between the two cases: the separate carriage obviates any apprehension that passengers could entertain from the danger of explosion, and will therefore be preferred by most passengers; but, for myself, I do not rate that risk so high as to be induced to encounter the complexity of the two carriages, and to forego some of that new security compared with horses which steam power offers by its controllability in descending hills and turning corners; and from which circumstance, as I have before stated, I think the plan of one carriage is much to be preferred, and probably the other objections, of heat, and noise, and dust, may be overcome by some new means, which have not yet been shown. In Mr. Hancock's carriage the boiler is quite behind, and away from the passengers, so that they are out of danger, if there is any, and are not materially annoyed by heat, or smoke, and dust, except at times when the wind brings it forward, and that rarely happens when the coach is moving."

"Is not the danger attendant on the bursting the boiler greatly diminished by the subdivision of its internal capacity into tubes, or small and flattened chambers? Unquestionably, until the danger of explosion has become exceedingly small; but the great difficulty of boilers for steam coaches is, that the liability to burn through the plates has been increased by that expedient for ensuring safety; and the progress of the invention has been impeded between those two difficulties, in a greater degree than from any other circumstance. It was a desideratum for a long time to contrive a boiler, which, being made of such thin metal as would not render it too heavy, should have sufficient strength to retain high pressure steam without danger of bursting; also that it should expose a sufficient external surface of metal to the fire and flame, and of internal surface to the contained water, to enable the required quantity of steam to be produced from such a small body of water as could be carried, on account of the weight: both these conditions were fulfilled by subdividing the contained water into small tubes, or into flat chambers, which expose a great surface in proportion to their internal capacity, and admit of being made strong with thin metal; but there is also another condition which is rather incompatible with the two former, viz. that there shall be such a very free communication between the interior capacities of all the tubes or narrow spaces, as will combine them all into one capacity, and permit the contained water to run from one to another, and also permit the steam, which is generated in innumerable small bubbles within the narrow spaces, to get freely away from them, and go to the engines without accumulating and collecting into such large bubbles as would occupy the spaces and displace or drive out the water before them; for, if that effect takes place, it produces three great evils; the water boils over into the engines along with the steam, and is wasted, and the thin metal which remains exposed at the outside to the fire, becomes burning hot in an instant, after the water is so driven away from the internal surface, and the further production of steam is suspended so long as the water continues absent. If such displacement of the water takes place frequently, and in many of the narrow spaces at once, the boiler will not produce its proper quantity of steam, and the thin metal will soon be burned through, and destroyed by the fire."

"Have you seen Mr. Hancock's boiler? Yes; I have had many trials of it; and I am well acquainted with Mr. Gurney's. The former uses flat chambers of thin iron plate, standing edgeways upwards over the fire in parallel vertical planes; the latter uses small tubes (such as gun barrels are made of,) to contain the water, the fire being applied on the outsides of the tubes. In Mr. Gurney's boiler I think the subdivision of the water into small spaces is carried too far, because the steam cannot get freely away out of such small tubes as he uses (and they are also of great length) without displacing much of that water which ought always to be contained within them. By an ingenious arrangement of connecting pipes and vessels, which he calls separators, he collects all the water which is so displaced along with the steam, and returns it again into the lower ends of the same tubes, and thus avoids the evil of water boiling over into the engines; but that makes only a partial remedy for the diminished production of steam, which is attendant on the absence of the water from the heated tubes, and the still greater mischief of burning and destroying the metal. Hence the evil of burning out the tubes is very great. Also his separators hold a considerable weight of water, from which no steam is generated; and they require to be heavy in metal, to render them quite safe and strong. Mr. Hancock has taken the middle course in subdividing the water in his boiler, having all that can be required for safety, and the weight, I believe, on the whole, to be less than that of any other boiler which will produce the same power of steam; for, owing to the freedom with which the steam can get away in bubbles from the water, without carrying water with it, the surface of the heated metal is never left without water. Hence a greater effect of boiling is attained from a given surface of metal and body of contained water, and that with a much greater durability of the metal plates, than I think will ever be obtained with small tubes."

"Do you think there is a danger of such an explosion as could do injury from the mode in which Mr. Hancock's boilers are constructed? That danger I hold to be very slight; the metal of Mr. Hancock's chambers will burn through in time, the same as that of Mr. Gurney's tubes will do, but not so soon. I think, taking the thickness of metal to be the same in both cases, no injury will be done by such burning through. The flat chambers in Mr. Hancock's boiler are very judiciously combined, and are secured against bursting by causing the pressure which tends to burst each one open, to be counteracted by the corresponding pressure of the neighbouring chamber, and the outside chambers are secured by six bolts of prodigious strength, which pass through all the chambers, and unite them all together so firmly that I see no probability of an explosion. Mr. Gurney's vessels, called separators, are secured by hoops round them, and, being of a small size, may be made very safe. Hence I think the two boilers may be put on a par as to their security; but there is a decided preference, in my opinion, of Mr. Hancock's form of subdividing the water and steam compartments, which I believe is carried too far in Mr. Gurney's tubes, whereby the water included within the several tubes, cannot make way to allow the bubbles of steam to pass by it. This is owing to the great length and the small bore of the tubes; and they are so isolated one from another, that the water within them is not able to act as a common stock of water, or to keep all the interior surfaces of the metal tubes thoroughly supplied with water: thence, there is a deficient production of steam and an unnecessary destruction of metal."

"Are you aware that in Mr. Hancock's carriage, the waste steam, which is discharged from the engines after having performed its office, is thrown into the fireplace, and makes its escape upwards along with the flame, smoke, heated air, and gas, which ascend from the fire, to act on the boiler? That is the way in which he gets rid of the waste steam which the engines discharge, and I understand that he thereby avoids the puffing noise and appearance of steam which is common with high pressure engines. Mr. Hancock blows the fire with a current of air produced by a revolving fanner, which is turned rapidly round by the engines, and therefore he requires no tall chimney to produce a draft. Mr. Gurney formerly used a fanner to blow the fire, and also a chimney of some height; but I understand he has lately laid the former aside, and adopted the plan of carrying the waste steam, which has passed through the engines, into the bottom of the upright chimney, and there discharging that steam through a contracted orifice in a vertical jet, which, by rising upwards with great velocity in the centre of the chimney tube, gives a vast increase to the draft of heated air and smoke in the chimney tube, without any great height being necessary; and this plan occasions a most active current of fresh air to pass up through the fire, and urge the combustion. This is a most important improvement in locomotive engines, which has been introduced by Mr. Stephenson into his engines on the Liverpool and Manchester railway, and being there combined with an improved boiler, it has been one of the great causes of the brilliant success of that undertaking. I believe the same plan will be indispensable to the complete success of steam carriages; for chimneys cannot be used high enough to obtain a draft, and blowing the fire is a very troublesome affair. I fear Mr. Stephenson's plan would occasion more noise than is allowable on common roads; but that may perhaps be avoided, or diminished, by some new expedient."

"Do you think any danger would arise from the waste steam being discharged over a large mass of fire on Mr. Hancock's plan? Not the least danger; all the waste steam which blows off at the safety valve, and which the engines do not require, is got rid of in the same way; but I expect Mr. Hancock does not help the combustion of the fuel by thus mixing the waste steam with the flame before it acts against the boiler. Mr. Stephenson's improvement, which Mr. Gurney has adopted, is to discharge all the waste steam into the bottom of the upright chimney with a violent vertical jet, in order to accelerate the draft up the chimney. The waste steam, therefore, is mixed with the smoke and gas, after the smoke has ceased to act on the boiler. The waste steam was very commonly discharged into the bottom of the chimney, in Trevithick's high pressure engines, many years ago, in order to mix with the smoke ascending in the chimney, and thus to get rid of the waste steam; it improved the draft in that way, by rendering the smoke more buoyant, though only in a slight degree; but the waste steam was not discharged through a contracted orifice to give it velocity, nor was it directed upwards as is now done by Mr. Stephenson; whose vertical jet of steam in the centre of the chimney, gives such an intensity of draft through the fire as was never procured before, and, with the further advantage, that the rapidity of draft so produced, increases whenever the engines work faster, and discharge more steam, just in proportion as the demand for fire and steam increases by that faster working.

"Is there any noise occasioned in that way? Yes; but the sound is directed upwards by the chimney, and is not much heard in the locomotive engines on the rail-way when they are in the open air, but when they pass under the bridges, the sound is reverberated down again by the arch, and then it sounds very loud. The noise is no great consequence there, and no particular pains have been taken to avoid it. The metal pipe of the chimney has something of the effect of an organ pipe or trumpet, but it is probable the sound might be deadened."

"Will the burning out of the plates of Mr. Hancock's boiler, that you spoke of, be attended with risk of explosion of the whole boiler, or only of the smaller divisions of the boiler? It will be attended with no violence which could be called an explosion, nor with any danger whatever, but only with the inconvenience of disabling the carriage until the ruptured chamber is replaced by another. The rupture, or crack, of the metal plate at the burned place, would let out the water and steam very gradually into the fire, and probably extinguish it. All steam boilers burn out in that manner, sooner or later. The different chambers of Mr. Hancock's boiler are kept together by six very strong bolts, which pass through them all, and which are quite protected from the action of the fire; to burst the boiler those bolts must give way altogether, and there is no adequate force to produce any such effect."

"Are you acquainted with the construction of the new steam carriage which started this week from Gloucester to Cheltenham? I am not, further than that it is on Mr. Gurney's plan."

"Apprehension has been felt that these steam coaches will be found to give great annoyance to travellers passing them on the public roads, from smoke and the peculiar noise from letting off the steam; do you apprehend such results will take place? I do not anticipate any great annoyance will result to travellers in other carriages. I have passed Mr. Hancock's on the road several times, and Mr. Gurney's also, and have travelled in them often; horses take a little notice of them when in motion, but not much, and very soon become accustomed to them. I once met Mr. Hancock going very quick along the New road, and drew up to see him pass; I had no difficulty whatever in making my pony stand, though rather a spirited one. Mr. Hancock did not observe me; and as I wished to go with him, I turned and drove after him, and after a race to overtake him, I had no difficulty in drawing alongside of his steam carriage for a good way, in order to speak to him, and get him to stop for me. The emission of hot air was very sensible, when following close alongside of the boiler at the hinder end of the carriage, but I did not observe any puffing of steam."

"Do you think that whatever annoyance exists in the present steam coaches may be removed by the improvement of the carriage, and particularly the appearance of the carriage? Certainly their appearance may be improved; as they are now most unsightly. The general question of farther improvements in steam coaches depends upon the general mechanical skill and judgment of the mechanicians who turn their attention to the subject, and the peculiar experience they acquire in this particular branch of mechanics, by continually practising and exercising with steam carriages, on roads of all kinds, in all weathers, to find out their defects, and how to remedy them, and what is the best mode of management; also, by building new and better carriages as soon as they have learned what will be better than the present ones. But all this must be at a great pecuniary loss, and some further encouragement must be held out in order to induce the more skilful mechanicians to embark in such a pursuit; for, at present, it is by no means an object of attention to our best and most competent engineers, because they know they would only throw away their money and time by undertaking steam coaches, even if they were to succeed ever so completely. The patentees are a different class of men; they are the inventors who have first organized and arranged the combination of machinery which is to be used; and according to law, they have acquired a legal property in those peculiar combinations which they have discovered, that has been their encouragement and stimulus to exertion; but the terms of their patent rights will be very likely to expire before their inventions come into use to such an extent as will repay them their previous costs with any profit thereon; and also, with the present defective state of the law on the subject of patents, they will be unusually lucky if they are able to make good their patents at law, in case their rights are contested. The patentees are not experienced mechanicians, or engineers, and have had to learn the business of engine making and of coach making as they went on; and a great deal of the deficiency of the present steam coaches has arisen from the circumstance, that they have been made by persons who were not at that time qualified to execute either a common coach or a common steam engine; but they have acquired more skill now, and we may expect more finished productions from them in future. There is no mechanician, of the class of those who will be ultimately employed to make the engines and machinery of steam coaches when they do come into use (and who alone can give that perfection of design, proportion, and execution, which is essential to their coming into use,) who will have any thing to do with them now; not so much from any doubts that they would not be able to succeed in perfecting them, as from a conviction that the expense of attaining success would be greater than would be repaid by any advantage they could afterwards derive from making such machines, in open competition with every other mechanician who chose to copy after their model when perfected; for the perfection of design, proportion, and execution, in which steam coaches are now wanting, though very laborious and expensive of attainment, would not be a ground of claim for exclusive privileges under the existing law of patents. The patents to the first inventors are the only ones which are professed to be recognised by law, though in effect they can scarcely ever be maintained at law. That is a very important point for the consideration of the committee, and one which deserves great attention. As the law of property in inventions now stands, when a new invention is advanced to such a stage that it may be considered to be tolerably perfect as an invention, no further exclusive privilege can be maintained to compensate for the skill, labour, and expense, which must be incurred to find out those true proportions, dimensions, weights and strength, which are essential to bring it to bear as a practical business. The law professes to give the whole to the first inventor, although he may have only laid the foundation on which another has raised the superstructure; and if, as usually happens, the claim of the first inventor is set aside, from technical informality in his title deeds, and also when his term expires, the whole superstructure lapses to the public. For these reasons, those who are the most competent to the task of giving the finishing touches of practical utility to great inventions, are kept back by being aware that they will not be repaid. Under such circumstances, a defect of judgment would be proved *a priori* against any one who might commence such an unpromising pursuit, and that want of judgment which could permit a man to overlook the pecuniary considerations, would not be favourable to his success as a mechanician, in giving that precision of form and dimensions, and that practical utility, to an invention which requires an exercise of the cool judgment resulting from experience, rather than of the genius depending upon original thought."

"You do not consider the inconveniences of the present steam coaches to be inseparable from the invention? Certainly not; but I do not think that any of the individuals at present engaged in the pursuit are the most competent persons who could be chosen to overcome the remaining difficulties, being inventors, who have almost completed their parts of the task, and not experienced practical engineers, into whose hands the affair of building the next steam coaches ought now to pass, under the general direction and advice of those inventors. If the building of steam coaches is continued in their hands, they will advance towards perfection of proportion and execution only by slow degrees, as the patentees acquire that general skill as engineers and mechanists which is already possessed by professional engineers."

"You think that the machinery may be improved by better mechanists? I have not the least doubt of it; and yet those mechanists are not the proper men of genius to have invented what has been hitherto done by the patentees."

"Apprehensions have been felt by trustees and surveyors of roads that steam carriages are more injurious to roads than carriages of equal weights drawn by horses; what is your opinion upon that point? I should not apprehend that the present coaches are injurious in a greater degree than other carriages of equal weights; and when steam coaches are really brought to bear, I think they will be much less so than any carriage at present in use, taking horses and the carriage they draw, against engines and the carriage they impel, at weight for weight. All my observations upon steam carriages have led me to believe that they do no particular harm to the road. I could never perceive any particular marks that they left in their tracks, and an examination of the iron tire on the edges of the wheels of Mr. Hancock's carriage, shows, evidently, that no slipping takes place on the surface of the road; which fact is proved to a certainty by other observations on the working of that carriage. It will be a long time before a sufficient number of steam carriages travel over any road to bring their effect on the materials to the test of experience; but, on general principles, I have no hesitation whatever in stating my opinion that they never will answer as long as they do injure the roads any more than the fair wear occasioned by the wheels of other carriages of the same weight; for any injury they might do to the road must be by the slipping of their wheels on the road, which would be a waste of the power of their engines, and hitherto they have had no power to spare; or, if their wheels are too narrow, and they cut deep into the road, the power of the engines will be wasted. If they are to be efficiently advanced, the whole power must be fairly exerted in advancing them forwards along the road, without turning their wheels in vain on the road, or cutting ruts in it. I am confident that, if the wheels slip at all on the roads, so as to lose motion, or if they penetrate so as to make ruts, those coaches will not answer; and therefore that the defects must be remedied, or the coaches given up. I do not mean to affirm whether the present steam coaches which draw other carriages after them, do or do not slip on the road, because I have not examined them; but I am of opinion that, for the ultimate successful application of steam power, the carriages must be so constructed that they will do less injury to the roads than carriages drawn by horses; and whenever steam coaches become common, I think the roads will be most materially benefitted by the change."

"Supposing the total weight of a stage, or mail, coach, drawn by four horses at ten miles an hour, to be two tons, and the weight of the four horses to be two tons, what proportion of the wear of a Macadam road would you expect to be occasioned by the wheels of the coach, supposing them to be the usual breadth of stage coach wheels, and what would be the wear by the horses' feet? It is impossible to fix an accurate proportion for such a question; but I have no doubt that, weight for weight, horses' feet do far more injury to a road than the wheels of a carriage, and particularly so at quick speeds, because wheels have a rolling action on the materials of the road, tending to consolidate, and the horses' feet have a scraping and digging action, tending to tear up the materials. One test of the wear by horses' feet will be in the wear of towing paths for canals, and the rail-way roads where horses are employed. In either of those cases, the number of horses which pass along is so small that no turnpike roads afford any example of comparison, and yet the wear of towing and rail-way paths is found to be considerable. The rapid wear of horses' shoes is another test."

"It has been stated, by a previous witness, that the proportion of the wear of a Macadam road, under such circumstances, would be about two-thirds by the horses, and one-third by the carriage; should you think that a fair approximation to the truth? I have no means of judging with such precision, but I have no doubt whatever that, in the case above supposed, the wear by the horses' feet would be much greater than the wear by the wheels; for, independently of the difference of the action, as before stated; the rapidity of the blows wherewith the horses strike down their feet, in stepping quickly, wears the road, and they keep their feet pressing on the same spot for a sensible time afterwards, which must have a far greater effect on the materials, to wear and loosen them, than the comparatively progressive rolling of the wheels over the road, because the latter remain only an imperceptibly short space of time on the same spot, and have a consolidating action.

"May you take the wear of horses' shoes, in proportion to that of the tire of the wheels, as a fair test of the proportionate wear of the road by each? No, by no means; because the pressure which the wheels exert, and which wears away the tire, is, under certain conditions, very beneficial to the road; whereas the pressure occasioned by the horses' feet is in all cases pernicious. On a gravelled road, which is not yet consolidated, the rolling action which causes the wear of the tire of wheels produces a great improvement of the road, when the treading action, which causes an equal wear of horses' shoes, does nothing but mischief. The harder and more solid the road becomes, the less this may be apparent, because the wear of the road becomes so imperceptible; nevertheless, I think the proportion of less wear by wheels than by horses' shoes, will still hold true.

"What is the average width of the tire of the wheels of steam carriages which you have tried? Mr. Hancock's wheels are two inches, and three inches, broad; in Mr. Gurney's carriage, when he carried the load along with the engines, the wheels were two inches and a half broad; but I understand he has widened them since he has altered his system of drawing a separate carriage, which is to be expected as a necessary consequence of the alteration.

"Do you think the machine would act with less advantage if the wheels were wider? That depends entirely upon the weight resting upon the wheels, and the sort of roads they are to run upon. I think it would be better for those individual carriages to use broader wheels than they had.

"If the tire of Mr. Hancock's were six inches broad, would it be an advantage or a disadvantage? I think six inches would be too wide for that description of carriage; about four inches I should think a suitable width for his wheels. Mr. Hancock's carriage is so arranged, that a greater proportion of the whole weight of the carriage is thrown upon the hinder wheels, to one or both of which the power of the engines is applied, than upon the fore wheels: which I think is very judicious, because it ensures such an effectual adhesion of the hind wheels to the road, that no slipping can take place. The breadth of the wheels must be so proportioned to the pressure they exert on the road, that they will not so indent or press in, as to leave deep marks behind them. The actual breadth that will be suitable to any given weight will depend upon the hardness of the materials of which the road is made, and roads differ very much in that respect. I think that, in all cases, the breadth of wheels which will enable the carriage to make the best progress, will be that which will do the least injury to the road, for it will be that which will occasion no disturbance of the stones after they have been consolidated, but will only wear away their upper surfaces, and the iron of the tire.

[TO BE CONTINUED.]

¶ ON WORKING IRON AND STEEL.

(Concluded from page 200.)

From what has now been stated, it will be seen that there are two causes for the failure of steel, more particularly if used quite hard. The first is an unequal combination of carbon with the iron, and this is more or less the case with all steel till sufficiently hammered; the toughness of some parts, the brittleness of others, and the different states of tension hence arising, render the metal very liable to crack, if not in the hardening, yet afterwards, when forcibly struck as metal dies are.

The second cause is bad hammering; for I think I have shown above, that however much hammered, it yet may be left in a most violently conflicting state, some parts girded and pressed, while others are as powerfully strained, almost to breaking; and if hardened in this state, how can it be expected to stand? and thus springs, though very equally formed, may be very unequal in their strength.

Well hammered steel requires the least tempering to give it the necessary degree of toughness; but when hardened from a great heat, it loses all the previous condensation from the hammer, and with it so much strength that the toughness disappears, and the same hardness with less strength shows itself in brittleness. Steel, therefore, of this inferior strength, requires more letting down by tempering, to arrive at a sufficient degree of toughness to bear using. Such tools are too weak and soft for turning steel or iron, and do not stand long for any purpose.

I believe there is a given degree of cold to which the steel must be brought in 'a given time, to cause hardness; also a given degree from below which steel will not harden; and that all farther increase of the heat only weakens the steel, and all further increase of coldness serves only to harden a greater mass, or a deeper coat of a large mass, by cooling it in the required time.

Steel much overcharged with carbon, is too harsh, or brittle, to receive all the improvement that hammering would otherwise give it; but by choosing the most malleable steel, already sound, and hammering it at a heat so low as to be capable of holding a coat of carbonaceous matter, it will imbibe the carbon so slowly and in such small quantities during each hammering, as to enable the workman to bring it up to the fullest charge compatible with sound hammering; and so far carbon must improve the strength; but beyond that, brittleness comes on, and it refuses to receive any condensation from the hammer, by which alone toughness is given. It is of no use seeking for hardness unaccompanied by toughness, for we should have to let it down to prevent breaking; yet many believe the hardness to be increased by coming up to this brittleness; therefore, taps, dies, and turning tools, in order to increase their hardness without losing toughness, are allowed to receive a little more carbon on their surface, by putting them in red hot carbonaceous matter for the hardening, the toughness of the metal within remaining the same. For this purpose animal charcoal appears best. I have chiefly used burnt leather, which seems capable of a sort of fusion on the surface of the steel while coming to a red heat, and therefore imparts the carbon much quicker than wood charcoal; and in all cases of hardening it is best to heat the steel in close vessels, or a case of some sort, to protect it from air and prevent carbon burning out of the surface. Water damages the surface at the moment of plunging; to prevent this, small articles are frequently plunged into oil or tallow, which has the reverse effect, for it rather restores the surface. Files, and other tools that do not admit of being sharpened, are left quite hard; also tools for cutting steel; but in all other cases, to prevent the risk of breaking, the extreme hardness is removed by tempering more or less, as the intended work will allow.

Various methods have been resorted to, in order to measure the exact temper, and more particularly for long thin articles, such as watch springs, which are difficult to heat uniformly. Melted metal, the fusing point of which is just under the right temperature, has been used; but if the mercury, or other melted metal, be in sufficient quantity, and the heat be measured by a thermometer, it will secure accuracy: the article being moved about in this till of the same heat in every part, and all through, will be well tempered, let the shape be what it may.

Heating the articles in oil till the smoke rises copiously gives a good temper for tools for brass work, and a still lower temper is given when the oil catches fire—this is called blazing off; but for articles of any substance, colour is the simplest and most direct criterion. The hardened steel is ground clean along one side, and kept perfectly free from greasiness; it is then heated, in preference at the side of a fire to avoid smoke, carefully watching the bright part until it becomes of a straw colour, it may then be cooled in water to prevent the spread of heat from parts not cared for; this temper suits tools for brass work; but if heated till it becomes brown, bordering on purple, it suits tools for pewter and very hard wood; after this it becomes blue, indicating a suitable temper for the softest carpenter's tools, table knives, and springs; it is just low enough to bear filing, and in thin pieces will bend a little before it breaks; if heated beyond this it turns gray, and is almost visibly red in the dark. Very thin springs are observed to be stiffer while the blue colour is on than when cleaned off; and on re-bluing them, they regain their stiffness, although there is no alteration of the temper; such springs are therefore preferred with the blue colour on.

These colours may be given to hard or to soft steel, and when cleaned off, the same heat will always restore them. The steel and screws of watches are generally blued for ornament; the other colours, when given merely as a guide in the tempering, are cleaned off. I have found the slow conducting power of lamp black a useful agent to preserve particular portions from being hardened with the rest.

It is sometimes desired to harden the neck of a mandril and not the screw, lest it should break when roughly used: this may be done by an iron tube fitted a little way on the neck of the mandril, and ramming the space between full of lamp black, so as completely to envelop the screw, then shut it in by a disk to serve as a wadding; the mandril being then made red hot, and plunged in water, the exposed part will be hard, and the covered screw will remain soft.

Steel hardens as well under cover, as if exposed, provided it can be cooled in the requisite time; small articles, for watch work, have accordingly been hardened quite clean, and their brightness preserved, by filling a brass box with them, capable of being shut air-tight while in the fire, and then plunging the box with its contents in the water. On opening the box when cold, the articles are found hard and clean. Very fine drills or wire may be hardened from the flame of a lamp or candle, by merely shaking them quickly in the air, as that will cool them soon enough. Large masses require rapid motion in cold water to enforce their cooling in the requisite time. The largest masses that can be hardened are best done under a waterfall, the force of which beats away the steam as fast as formed, and keeps the surface cool while the central heat is escaping through it; and they should remain in this situation till quite cold throughout; if taken out sooner, the central heat will spread to the inner side of the hard shell and expand it, while the outside may be cold, and therefore will be liable to burst.

I met with an evident case of cracking, when hardening from badly hammered steel which also was unequally carbonized. The pieces were ovals, one inch long, filed out of steel bars one-tenth of an inch thick; they were then hammered, which condensed the middle and stretched the outside; in this state, they were heated in a crucible full of charcoal powder, (which probably carbonized the outer edge most,) and hardened by plunging in water; this cracked them all in the middle, the most condensed part, and none of the cracks extended to the outside.

Stamps and medal dies are an important application of steel; and to enable them to be hardened sound, and to stand in use when hardened, requires the metal to be in a state of perfect ease, the result of equal condensation all through, and this can best be secured by hammering in a recess.

For this purpose, it would be very desirable to ascertain, by experiments, the greatest thickness that can be hardened all through; also the state of carbonization most favourable to the greatest thickness; or, what is the precise difference in this respect between the most mild steel and that which is highly charged with carbon. Likewise, in very large masses, what is the greatest depth from the surface that can be hardened, and whether greatly hammering it would cause any difference in the thickness of the hard crust. This would of course require the pieces so hardened, to be afterwards broken to examine the interior; and where a soft nucleus occurred, it would require to be ground flat, to show what sort of boundary there would be between the hard and the soft parts; for it would be rendered visible by the very different texture which grinding produces in hard and in soft steel; and there must be some difference in the durability of a block, according as the boundary is well, or ill, defined.

We are so familiar with small flaws in articles of iron as scarcely to notice them, for their cheapness enables us to use the good and throw away the bad—such as nails, brads, screws, &c.; but our attention is drawn to large flaws, from the serious consequences likely to attend their giving way.

But in steel nearly the reverse takes place, as it is used so much smaller than iron, in things of consequence; therefore the smallest flaws are frequently of as much importance as the largest, for they occasion the breaking of tools, frequently spoiling the work; and when small work is nearly finished, hidden flaws destroy it; they also help to crack large masses when hardening.

But when the utmost efforts of the human mind are transmitted to steel plates, from which the delights of peace and civilization are spread abroad, it becomes of the greatest consequence to avoid every flaw, and even chemical dissimilarity; for though the metal be sound, it may be so unequal in its nature as to etch very badly, and the smallest flaws will spread very broad while drawing into thin plates; and when the etching, or graving, reaches through to such a flaw, the work is spoiled; laminæ of engraved work frequently coming off, as engravers have already seriously experienced.

For such works, therefore, cast steel should be employed: it should receive an extra degree of forging, most perfectly to equalize its composition, and reduce it to a mild state, for on this depends good etching; then the surface should be watched and kept clear, while reducing it to a usable thickness, that no flaws may be beat in: all welding must likewise be avoided, for fear of shutting in flaws; and if rolled into plates, it will require good hammering afterwards to restore the strength, or soundness, which it loses laterally while rolling. The especial reason why the primary forging should be long and carefully performed, is, that the etching is liable to be rough or smooth, as perfect homogeneity is more or less obtained, and it will be cloudy if different parts of the plate differ in their dose of carbon.

It would be desirable for engravers to make themselves well acquainted with the difference of action of the same acid on pure decarbonized steel, on ordinary steel, and on highly carbonized steel, and also on steel in the softest as well as in the most condensed state; for they would thus judge better whether the defects were in the metal or the acid.

CORNELIUS VARLEY.

[*Trans. of Soc. for Encouragement of Arts.*

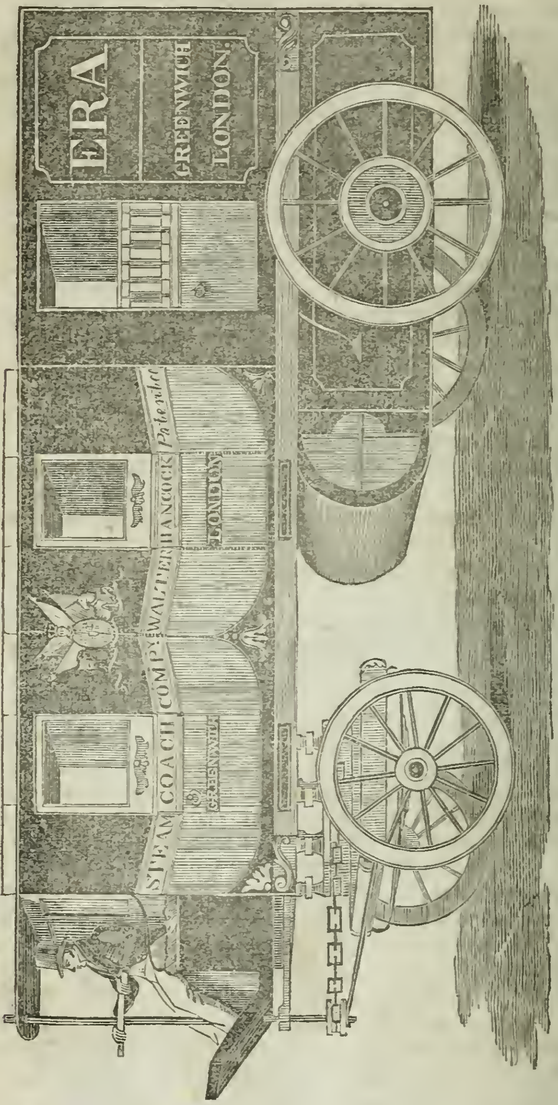
¶ *Iron Roofing.*

Your correspondent, at Peterhoff, has not given you the best mode of covering an iron roof, to prevent its rusting. Coal tar, brought to 220 degrees of Fah. and mixed with red lead, (genuine,) in the proportion of eight of tar to one part of lead, forms a composition which resists oxidation of the iron plates, or wrought iron of any shape, better than any other material whatever. Oil, and every mixture of metallic oxides with oil, give to wrought iron a tendency to scale off in large flakes when subjected to changes of temperature. At the present price of iron, it is much cheaper to cover a roof with sheets of that metal than with any other material whatever—and more especially where the plates are coated under and over with the above composition. Fine sand must be strewed on the surface, quite dry, and the work must be executed in dry weather.

[*Mech. Mag.*

¶ *Hancock's Steam Carriage.*

The annexed engraving represents a new steam carriage, which Mr. Walter Hancock has just built to run on the road between London and Greenwich.


ERA
GREENWICH
LONDON.
STEAM COACH COMPY WALTER HANCOCK Patentee
LONDON
GREENWICH

For the following particulars of its construction, we are indebted to Mr. Gordon's valuable Historical and Practical Treatise.

There are two engines, which are placed before the boiler and turned with the stuffing box down, so that the cylinders are uppermost, and the piston and connecting rods below. The crank shaft, with two cranks, is supported by a flexible frame, which provides for any concussion on rough roads. A chain passes over a sheave on the crank shaft, and over a larger sheave on the hind axletree. The wheels turn loose on the axle, and one or other, or both, are fixed by a clutch when required. This clutch is on the outside of the wheel, and can be screwed out, or in, as the case demands, with great facility. The turning of the carriage round to the offside, is prepared for by throwing out the off side clutch, and keeping in the near one; and the turn round to the near side, is prepared for by throwing out the near clutch, and throwing in the off side clutch. A little play is left between the catches in each clutch, so that a winding road may not oblige either wheel to be disengaged; and it is only in a short turn, or a turn round, that the clutch must be shifted, and this can be done in a very small space of time.

Fig. 2.

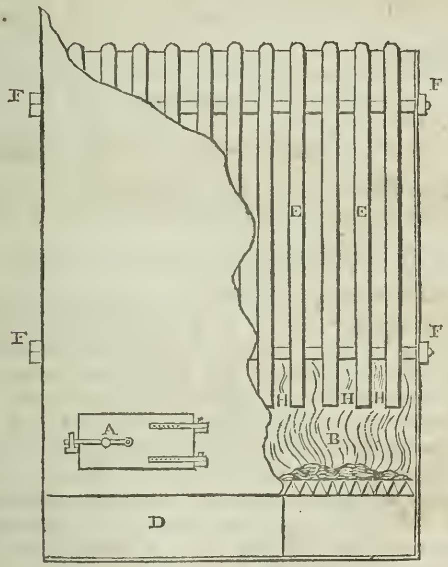


Fig. 2 is an elevation of the boiler, with part of the casing removed for the purpose of exhibiting the interior structure. A is one of the fire doors, of which there are two. B the fire place; D the stokehole; E E the chambers, constructed of the best wrought iron; F F shows the manner in which all the chambers are bolted together, so as to form a large boiler of many compartments. There are fillets of iron, which keep the individual compartments at a proper distance from each other; and these spaces which the fillets leave are the flues of the boiler, through which the flames ascend as shown at H H H. All these compartments are connected at the bottom for the purpose of keeping the water in each at the proper level; and at the top the steam is conveyed from each by as many pipes as there are chambers into the steam feed pipe, by which the steam is conveyed to the engines. By this arrangement, the only parts of the boiler which can be dreaded are the sides; but good ties will keep them together. And as to the bottom end, and top of the boiler, which are composed of the edges of these compartments, if one part is burnt out or hurt, it is only that individual compartment which can burst, and its power of doing mischief is not worth notice. The fire is urged by a blower, which is driven by a connexion with the engines. The waste steam is blown from the engines into the chimney, and so destroyed. The passengers are carried on the same machine, Mr. Hancock preferring that disposal of the weight to the dragging of it in a carriage behind. The wheels of the carriage are a beautiful exhibition of strength and lightness combined. The spokes are all wedge shaped, and where they are fastened into the nave, abut against each other. Their escape laterally is prevented by a large iron disc at each end of the nave; and these being bolted through, confine the spokes securely in their places.

[*Mech. Mag.*

¶ *Mr. Gurney's Steam Carriage, applied to rail-ways.*

We have been favoured with the following copy of a letter from William Crawshay, Esq. to Lieutenant-Colonel Sir C. Dance—

Cyfaithfa Iron works, 23d February, 1832.

My Dear Sir,—I regret that my occupation at this moment prevents me giving you the ample reply I could wish, to your inquiry as to the working of Mr. Gurney's engine on our rail-road at Hirwain. I can, however, state to you in general terms, that the favourable opinion entertained by my engineer and myself of the tubular boiler, over every other we have yet seen, not only remains unshaken, but is strengthened and confirmed by eighteen months constant use and observation of it on our own road; and, also, by all we can collect from other testimony, of what is doing elsewhere in this neighbourhood with boilers of other description. The ease and economy of first construction, the facility of repair when required, the extreme lightness, the great capacity for raising steam, and the perfect freedom from danger of the tubular boiler, all render it, in our opinions, pre-eminently adapted to locomotive engines; and I hope in the course of a few months, to apply it to engines and carriages, suited to rail-roads and heavy work, so successfully as to render the advantage of steam power over that of horses, still greater than it now is. As, however, facts of past performances of any kind are more satisfactory than anticipations of the future, I beg to state to you, that in the past twelve months, between the 1st day of January, 1831, and the 1st day of January, 1832, the locomotive engine which I bought of Mr. Gurney, weighing only thirty-five cwt. including every thing whatever belonging to it, with water and fuel in a working state, conveyed 42,300 tons of coal, iron stone, and iron, exclusive of the carriages on which they were drawn, the distance of two and a half miles upon our rail-road at Hirwain, in journeys of from twenty to thirty tons, as suited our convenience; during which time the entire consumption of coal was 299 tons, which at 3s. per ton, amounts to £44 17s. The wages of the engineer £52, and those of the boy £15 12s. together, exclusive of the trifling repair of the engine, and the oil and other little matters required for its use, £112 9s. or less than one farthing per ton per mile, for the goods conveyed; and I must not omit to observe to you, that had there been nearly double the work to do on this road, the engine would have done it with little or no increased expense, as she was invariably working idle, for the purpose of keeping the boiler full, about one-half of her time.

You are sufficiently acquainted with the experience of horse power to render any comparison on my part unnecessary, but from the observations I have been enabled to make, in contrasting horse power with that of steam on the same road, I should certainly consider that the average of horse power, compared with that of steam under the most improved application, is, in point of expense, as twenty or even thirty to one : independently of many other valuable considerations in favour of that of steam, known only to those who have large and expensive stable establishments, in which valuable horses, after sustaining hard work all day, are exposed to the negligence, roguery, and ignorance of hawliers, horse-keepers, and farriers, while the engine, having completed her day's work, may be left without anxiety as to the attention of any of these notoriously troublesome persons until again called into use.

I consider that the unprecedented depression of the iron trade, and the late disturbances in South Wales, have much impeded the further introduction, use, and improvement, of locomotive engines in this part of the country; and it is a matter much to be regretted, that more talent, competition, and energy, are not at this moment excited every where in the furtherance of so great a national advantage as the substitution of the cheaper power of steam, wherever practicable, for that of horses.

Wishing you every success in your zealous perseverance in this laudable object.

I am, sir, yours, &c.

WILLIAM CRAWSHAY.

[*Mech. Mag.*

Swing Hone.

The thanks of the Society in London for the Encouragement of Arts, &c. were voted to Mr. J. Fayrer, of Pentonville, for his swing hone for sharpening razors and other articles of cutlery. One of the hones has been placed in the Society's Repository.

The exquisite edge given by the cutler to razors, lancets, and other fine cutting instruments, can rarely be produced by those persons who are in the habit of using them. This arises partly from ignorance of the properties in which consists the difference between a good and a bad hone, and partly from want of that skill and slight of hand in the use of a hone, which long and constant practice only can give in perfection. Mr. Fayrer's hone is a plate of brass, about an inch wide, and of any convenient length, ground to a perfectly smooth surface on both sides; part of each end is cut or filed away, leaving only two pins, or pivots, on which the hone turns or swings. In the frame are two uprights with notches to receive the pivots. Two boxes are provided, one to hold a coarser and the other a finer powder made of oilstone ground down and washed over: for the latter, finely pounded water-of-Air-stone may be conveniently substituted.

To use the hone, first put on one of its sides a few drops of oil and a little of the rougher or coarser powder, then draw along it, in the usual manner, the edge of the razor or other tool to be sharpened. As the hone swings on two pivots, the surface necessarily applies itself quite evenly along the edge of the blade, in whatever direction the pressure of the hand is made that holds the tool; and the particles of the powder, as the operation proceeds, are continually becoming smaller and smaller, and therefore giving a finer and finer edge to the tool or blade. To finish the setting, turn uppermost the other surface of the hone, apply to it oil and the finer powder, and proceed as before.

Metal plates, both of steel and of tin, have already been made to serve the purpose of hones; but the application of brass as a material for this purpose seems to be new, as well as the contrivance of hanging it on pivots, in order to accommodate itself to the varying pressure of the hand. [*Trans. of Soc. for Encour. of Arts.*

TRANSLATIONS FROM FOREIGN JOURNALS.

New rollers for Inking Lithographic Stones.

[Translated for this Journal.*]

The rollers used in lithography for inking the stones, consist generally of cylinders of wood covered with calf skin, and stuffed with carded wool. Besides the inequalities which the surfaces of such rollers present, the seam uniting the two sides of the leather makes a ridge which spoils the uniformity of the inking, particularly when large stones are used. This has hitherto been a great obstacle in the progress of the lithographic art. This ridge had been reduced, and practice had taught a method of concealing, in part, the defects necessarily attendant upon the use of rollers with seams; but the inconvenience and many defects still remained to be remedied. M. Tudot, incited by an appeal of the Society for the Encouragement of National Industry, conceived the idea of making rollers of round plates of different substances cut with a punch, then threaded together on a cylinder of wood, pressed forcibly one against the other, and polished or trimmed. He has tried in this way chamois leather, calico, and calf skin. This last material answered best, and furnished rollers which were soft, without seams, and which distributed the ink uniformly. M. de Lasteyrie, a competent judge in these matters, observes that the ordinary (seamed) rollers are very quickly worn out, while those of M. T. will not be exposed to the operation of the same causes of wear and tear, and will, therefore, greatly outlast the others.

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* By request of the Committee on Publications.

The new rollers are rather higher priced than the common ones, but it is confidently expected that their continued manufacture will admit of a reduction in the price. M. Tudot has received a prize of 500 francs ($100) for the ingenuity displayed in his invention.

[*Mémorial Encyclopédique, &c.*

Method of removing Acid from the papers used in Lithographic Printing.

Most of the paper used in copperplate and lithographic printing has an acid reaction, due, doubtless, to the processes of whitening, or to the alum used in its manufacture. This acid soon injures the texture of the lithographic stones, and after, at most, thirty impressions have been taken, the stone *greases*, to use the expression of the workmen, and the impressions are imperfect. M. Joumar remedies this greasing of the stone, in a very simple way; he passes the paper intended to receive the impression, through weak lime water, which neutralizes the acidity; he leaves it through the night thus wet and *matted*, and on the following morning either dries it or takes off the superabundant moisture, keeping that degree of softness which the printing requires. The author of this simple and easy method of removing the acid from lithographic papers, has received a medal of the value of 200 francs, ($40.) [*Ibid.*

Lithography in imitation of Mezzotint.

Various attempts have been made to imitate the style of mezzotinto engraving by lithography. One of the methods tried was by *tamping*. This process had given some beautiful results, but the mellowness of the tints could not be obtained. Besides, in sketching on the stones and removing the superabundant ink with the scraper, for the clear parts, the grain of the stone was destroyed, and when the stone was heated, for the purpose of fixing the sketch upon it, a few engravings with tarnished and gluey tints were all that could be obtained. M. Tudot proposes another process in which the scraper is not used. He lays the lithographic ink on the stone with care, makes it penetrate into the grain by means of an instrument of horn, then with a point of ivory, or, in preference, with a small utensil composed of very fine and pointed threads of steel, he takes from the bottom of the grain as much of the crayon as he thinks necessary to produce the desired tints. This process, put in practice by able workmen, has produced designs rivalling in every particular engravings which have come from the hands of the most celebrated engravers in mezzotint. The artist, while transferring to the stone the conceptions of his genius, has every desirable freedom, is not embarrassed with any mechanical operation, and the process is very rapidly executed. In some trials, made in presence of the Society for the Encouragement of National Industry, the 800th impression was as beautiful as the first. M. Tudot has received for this application a gold medal of the value of 2000 francs, ($400.)

[*Bulletin of Soc. for Encour. of Nat. Ind., &c.* 20 *Dec. and Ibid.*

Cure for Painter's Colic.

Plumbers, manufacturers of white lead, painters, printers, &c. and, generally, all persons exposed to the action of lead, are subject to this colic. Many remedies have been employed in this complaint; the one most generally adopted, and which has been attended with constant success, consists in administering emetics and purgatives. This method is obviously troublesome, and is besides expensive. M. Gendrin has communicated to the Academy of Sciences, a new remedy, viz. the acid sulphate of alumina and potassa, or common alum, dissolved in a sufficient quantity of water, and given in a dose of from one to three grains a day. This mode of treatment had been before recommended by Adair, Michaelis, &c. and is now in general use at the hospital of St. Anthony. The alum thus taken cures the malady completely in the space of from three to five days, without in the least weakening the organs of digestion. Its use in a dose of from one to one and a half grains,* is still more beneficial at the commencement of the attack; twelve or fifteen hours are then sufficient to remove all the symptoms. M. G. considers the efficacy of the alum to be probably due to the sulphuric acid, which enters into its composition. In fact, a sulphuric lemonade, made of one gros† to 1½ of acid, in twelve litres‡ of water, given to persons suffering under the painter's colic, has produced a complete and speedy cure. The sulphuric acid thus used with water as a lemonade, is as well as the alum, a sure preventive if taken on the first symptoms of the attack. If these simple receipts for the prevention and cure of a terrible complaint, are supported by further experience, M. G. will have rendered a great service to many useful and laborious classes of manufacturers and artists. [*Ibid.*

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* French, 2-3ds of a grain troy. † 54 troy grains. ‡ 25½ pints.

Prizes awarded by the Society for the Encouragement of National Industry.

On the 28th December the Society for the Encouragement of National Industry held its public semi-annual meeting for the year 1831. Of twenty-one competitors for the prize offered for the best means of security against the explosions of steam boilers, and for such a form of boiler as would guard against the effects of such explosions, no one obtained the prize. Silver medals were awarded to the following persons—M. Hall, of Paris, for a combined safety valve and fusible plate: M. Roux, for a new kind of feeding pump; and M. Trimot, engineer and maker of steam engines, for his water gauge tube, and fusible plate applied to the boiler. [*Ibid.*

Laws of Friction.

Notwithstanding the ability of Coulomb, and the care which he bestowed upon all his experiments, his researches upon the subject of friction, the results of which are given in the memoirs of the French academy for 1785, were incomplete, and, in some respects, contradictory, and their accuracy has been, in consequence, suspected. The researches since made upon the same subject by Rennie, Vince, and others, have neither been sufficiently extensive nor precise to set the question at rest. Mr. Morin, by means of an apparatus better calculated for giving precise results than that of Coulomb, has lately made a new set of experiments, varying the velocity from the lowest up to ten feet and upwards a second. The rubbing surfaces also varied from some tenths of a square inch to nearly five hundred square inches, and the pressures from ninety pounds to 2000 lbs., and were carried even as high as 2500 lbs. All the experiments made within these limits agree in showing that the friction of surfaces moving on each other, is independent both of the velocity and the surface, and proportional to the pressure. Coulomb, it is true, had already inferred these laws, but he stated many exceptions to them, which, according to the present researches, do not exist. Coulomb supposed that in the case of oak moving over oak, the grain of the wood all running the same way and in the direction of the motion, the relation of friction to pressure was 11 per cent., while Mr. Morin found it to be 48 and 32. Mr. Morin found for elm running over oak 48, when the fibres are parallel, and 41 when they are perpendicular. He also rectifies the mistake of mechanics who believe the friction to be less between heterogenous substances than between those of the same kind, and shows that the friction of metals on wood is greater than that of oak on oak; thus when iron is made to move over oak, the ratio is .61; and in the case of copper over the same wood, the ratio rises to .62. These interesting experiments, a report upon which is to be made to the academy by Messrs. Poisson, Arago, and Navier, will be continued by the author, who intends to obtain, if it be possible, the coefficient of friction for all the materials employed in the mechanic arts, in building, &c. [*Academy of Sciences*, 12 *Dec.*

Compensating Pendulums.

After the pendulum was applied as a regulator to clocks, and the other parts of these instruments had been rendered perfect in their construction, so great a regularity was obtained that the variations caused by the expansion and contraction of the rod of the pendulum, became sensible. M. Henry Robert, clockmaker at the palais royal, and pupil of Braguet, has lately communicated to the Society for the Encouragement of National Industry, a more simple method than that in use for obtaining an exact compensation in pendulums beating the half second. The common method of compensation is to make the rod of the half second pendulum of a single platinum tube, and the bob of zinc; the difference in the expansions of these two metals is such, that by exact calculations a perfect correction is obtained. Robert directed his attention to the pendulum with a wooden rod, for the purpose of using it in ornamental time pieces, for which the zinc and platinum pendulum (gridiron) was unsuited, from the comparative plainness of its appearance. By a simple and easy device he has so constructed it as to protect it completely from the action of the atmosphere, so that it may now be substituted for the best metallic compensators, in every kind of clock. In the construction of this new pendulum, M. R. profiting, on the one hand, by the well known property possessed by the wood of the fir tree, of preserving its length unaltered in all changes of temperature, has been enabled to confine his attention simply to its tendency to warp, by the absorption of moisture from the atmosphere, and to prevent this encloses the rod made of this wood in a metal box; the expansion of the bob corrects that of the tube.

This simple pendulum unites all the requisites of a good compensator, while at the same time it may be put together with ease; it takes up little room, is of a very simple form, and may be placed in the most beautiful models where the pendulum is exposed to view.

[*Ibid.*

Preservation of Wood.

A method of preserving building timber from decay has long been a desideratum. The attempts hitherto made, have not, however, been attended with success. Timber for ship building is subject to a peculiar species of decay, called the *dry rot*, a method of preventing which would be exceedingly valuable. At the meeting of the Society for the Encouragement of National Industry, on the 21st December, Mr. Bréant, Assayer of the Mint, and an able chemist, exhibited several pieces of wood of many inches square, and several feet long, which had been prepared by him according to a new process, which is expected to preserve them from every species of decay. The details of the method have not been made public by M. B.; he has merely stated that the wood is soaked in saline solutions and in oily and resinous matters. These substances penetrate so completely throughout the mass of the wood, that when one of the blocks exhibited before the society was sawed in half in presence of the members, it was found to be thoroughly impregnated with them even to its very centre. M. B.'s process requires but two or three days for completion, even in blocks of wood of a large size. If further experience confirm what science has thus suggested, the difficult problem of the preservation of wood may be considered as solved. M. B. states that he will shortly be able to furnish timber of all sizes prepared in this way. [*Ibid.*

New method of determining the Strength of Bleaching Salts.

We have already described several processes of different degrees of exactness, for determining the strength of bleaching salts,* and now give another which, though not very accurate, is exceedingly simple, and may be executed by every one. If we pour into a graduated tube, one measure of common ink, and then add successively, proceeding by *fourths*, $\frac{1}{4}$, $\frac{2}{4}$, $\frac{3}{4}$, 1, $1\frac{1}{4}$, $1\frac{1}{2}$, &c. measures of water, we shall of course obtain inks more and more pale in the same proportion. Lines are to be drawn very near together on a sheet of paper, with the inks thus obtained; that is, for the sake of convenience, a line is to be drawn after each addition of the water, which method will readily give us lines growing regularly paler and paler in a fixed proportion. When this is done, we are to cut off with a punch, of the same size, small disks of the paper thus ruled, so that each disk shall contain lines of all the different strengths, from the deepest to the palest. If we now wish to determine comparatively the strength of a sample of chloride of lime (bleaching salts) we have only to take a small quantity of it, and wet it sufficiently to make a conical cake, the base of which must cover exactly one of the pieces of paper, upon which it must be suffered to stand for about five minutes. The number of lines effaced will then give the comparative strength of the chloride. As these trials are only comparative, we must always make use of the same ink; and a trial should have been previously made with paper ruled by it, and bleaching powder, the strength of which had been accurately determined by other methods; this previous trial furnishes us with our standard of comparison. In the case of bleaching liquors (as Labarraque's disinfecting soda liquid, or the chloride of soda, &c.) a given quantity must be poured into a graduated tube; the trial piece of paper is then to be introduced into the same, and there to remain for a determinate space of time, to be acted on by the liquid. While the action is going on, it is better to cover the piece of paper by a wine glass or tumbler. Some chloride of lime furnished by Mr. de Rezé, from the mines of de Vic, erased completely all the lines from a piece of paper, while the best chloride (of commerce) of Paris, destroyed only $\frac{25}{40}$ths of the lines of a piece of paper ruled with the same ink. [*Ibid.*

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* See this Journal vol. ix. p. 211 and 337, vol. x. p. 181, &c.

W.

Meteorological Observations for July, 1832.

Moon.	Days	Therm.		Barometer.		Dew point	Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise	2 P.M.	Sun rise.	2 P.M.		Direction.	Force.		
				Inches	Inches.				Inches.	
	1	66°	72°	30.00	30.00	66	S.	Moderate.	.10	Drizzle—cloudy.
	2	65	86	.00	.00	65	SW.	do.	.30	Rain—flying clouds.
☽	3	62	84	.5	.5	65	W.	do.		Clear—rain in the night.
	4	71	86	29.90	29.90	75	W.	Calm.	1.50	Fog—lt. cl'ds. rain in n't.
	5	71	81	.85	.90	71	SE.	Moderate.	.2	Rain—flying clouds.
	6	67	83	.90	30.00	71	W.	do.	.52	Cl'dy; fly'g cl'ds; slight sh.
	7	73	85	30.00	29.90	73	SW.	do.		Fog; fly'g cl'ds. thund. sh.
	8	71	79	29.85	.80	74	SW.	do.	.95	Drizzle; flying cl'ds. rain.
	9	68	71	.70	.70	68	SW.	do.		Rain—flying clouds.
	10	68	76	.65	.70	63	W.	do.		Cloudy—flying clouds.
☺	11	60	79	30.00	30.05	59	W.	do.		Clear day.
	12	62	82	.10	.10	62	W.	do.		Fog—clear.
	13	68	85	.4	.4	67	SW.	Breeze.		Fog—clear.
	14	71	85	.00	.10	71	SW.	do.		Fog—clear.
	15	74	85	.00	29.90	73	SW.	do.		Cloudy—clear.
	16	71	83	29.80	.80	73	SE.	do.		Clear—showery.
	17	71	63	.80	.85	58	SW.	do.	1.35	Rain—cloudy.
	18	60	63	30.00	30.5	61	NE. SE	Blustering.		Cloudy day—rain.
☾	19	71	77	29.80	29.70	69	S.	Moderate.	.15	Drizzle—flying clouds.
	20	66	76	30.00	30.5	59	W.	do.		Clear day.
	21	61	76	.5	.5	62	SW.	do.		Clear—cloudy.
	22	63	76	29.84	29.80	68	S.	do.		Drizzle—flying clouds.
	23	65	79	.74	.74	61	W.	Breeze.		Clear day.
	24	59	79	.84	.90	55	W.	do.		Clear—light clouds.
⊗	25	52	67	30.10	30.10	38	NW.	do.		Clear day.
	26	50	70	.10	.10	47	W.	Calm.		Clear day—sun eclipsed.
	27	52	74	29.93	29.93	56	W.	do.		Clear day.
	28	60	76	.90	.90	61	SSE	do.		Cloudy day.
	29	68	80	.94	30.00	66	SE. W.	Breeze.	.1	Drizzle—clear.
	30	64	83	30.00	.00	69	SW.	do.		Fog—clear.
	31	70	86	29.94	29.80	73	W.	do.	.50	Fog—thunder shower.
	Mean	65.16	78.29	29.93	29.93	64.4			5.40	

	Thermometer.	Barometer.
Maximum height during the month,	86. on 2d, 4th & 31st.	30. 10 on 12th, 14th, 25th & 26th.
Minimum do. . .	50. on 26th.	29.65 on 10th.
Mean do. . .	71.73 . .	29.93

JOURNAL
OF THE
FRANKLIN INSTITUTE
OF THE
State of Pennsylvania,
DEVOTED TO THE
MECHANIC ARTS, MANUFACTURES, GENERAL SCIENCE,
AND THE RECORDING OF
AMERICAN AND OTHER PATENTED INVENTIONS.

NOVEMBER, 1832.

On the arrangement of Safety Valves.

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Blairsville, Sept. 21, 1832.

SIR,—Should the arrangement for safety valves suggested below afford a probable remedy for *old* defects, without liability to produce greater *new* ones, please give the following remarks a place in your Journal, and oblige

Your obedient servant,
D. LIVERMORE.

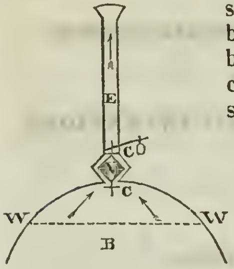
The experiments on the adhesion of disk valves, by Messrs. Hopkins and Roberts, as given in the last number of the Journal, seem to afford a probable solution of the causes of defective action sometimes observable in the safety valves of steam engines.

The reasoning of Mr. H. upon the subject, appears, however, more metaphysical than could be wished.

The experiments lead to the conclusion that adverse currents, or eddies, in the air discharged above the valve, contribute largely to produce the adhesive effects observed. The cause of these eddies may be traced to the enlargement of the discharging aperture immediately above the valve, giving room for sudden lateral expansion. This being likewise the case with safety valves of ordinary construction, we observe like defects in their operation.

It is, therefore, highly probable that valves so constructed as to give, when open, a uniform internal area for each cross section of the 'scape-pipe, would act with greater freedom and certainty. Suppose the valve conical both at top and bottom, or rather of such form as to embrace two perfect cones connected at their bases, and the seat formed by an enlargement of the 'scape-pipe, so proportioned as to give the same capacity for discharge around the open valve as in other parts of the pipe. The lateral expansion above the valve would be sufficiently limited, and the lower formation such as to prevent counter currents from having a prejudicial effect by producing a vacuity under the valve, as observed in the experiments of Messrs. Hopkins and Roberts. To secure a vertical ascent and descent, pieces projecting from the vertices of the valve should pass through two cross bars. The upper bar serves likewise to limit the rise of the valve to the height required.

The enlargement of the 'scape-pipe should give room for the discharge, equivalent to the space occupied by the upper bar; but the same advantage can be obtained for the lower bar by placing it a little below the top of the boiler. The whole arrangement will be sufficiently obvious by reference to the annexed sketch.



E, 'scape-pipe.
V, valve (open.)
C, C, cross bars.
B, boiler.
W, W, water line.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

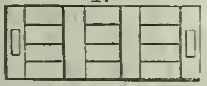
An abstract of the mode of Building in Pisé, or Earth Walls, with additional Suggestions, by J. D. Burr.

This method has been long practised with success, and very cheaply, in France and other parts of Europe. It is done by ramming moistened earth between planks or "mould boards," thus forming walls of cottages which, when dry, become firm, hard, and durable. Buildings are said to have been pulled down when nearly two centuries old, and that the walls were found still perfect.

In the first place, a preparatory brick, or stone, foundation must be built, to rise eighteen inches above the level of the ground, and of the thickness of the earth wall, which is usually eighteen inches at bottom, and reduced, or battered, to fifteen at top. This foundation is to preserve the wall from the effects of the splashing of rain.

The walls are formed by ramming earth of suitable quality (as hereafter described) between mould boards, which should be ten feet in length, and about two and a half feet wide, which are made like batton doors, and with four battons each from nine to twelve inches wide, two of them at the end, and two dividing equally the intermediate space; the boards should be of pine at least inch thick, strongly made, and tongued, and grooved, and planed smooth inside, and of equal thickness; on the end battons should be fixed strong cleats to serve for handles, (fig. 1:) only two of these mould boards are required. They are placed on each side of the foundation wall, beginning at one corner, and the outside mould is projected beyond the corner, while one end of the other mould is made to fit the inside of the corner, thus to support the earth that is to be rammed between the moulds.* The moulds are to lap on the foundation wall at least one or two inches, and they are secured in that position at bottom by two pieces of scantling (for which recesses must be left, or cut, in the foundation,) dressed smooth and true, three feet long, five inches wide, and three thick, with mortises at each end to receive strong tenons of upright braces and wedges to secure them in their proper distances, (fig. 2;) four upright braces in their tenons extending a foot or more above the mould board, are secured at top by ropes passing around each two opposite braces which are drawn and secured to their proper position by twisting the rope with a stick in the same manner as a wood saw frame is braced. Two gauges, (fig. 3,) of the length to regulate the slope and thickness of the wall at the top of the mould, are there inserted between, or by the sides of, the braces, (fig. 4.)

1.



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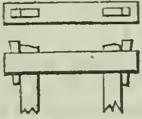

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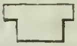

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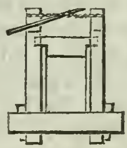

The earth used for these walls must be a strong loam, of such properties that on being rammed hard when slightly moist, it will become firm when dry; this must be ascertained by experiment, i. e. by ramming the earth in any small box, or vessel, strong enough to resist the pressure, and letting it remain till dry, when it will be nearly as hard and solid as brick. Most stiff soils are considered good for this purpose; a light or sandy loam may be made suitable by mixing with it from one-eighth to one-fourth of clay. The earth should be well pulverized, and thrown up in ridges so that the lumps will roll down and be broken. The proper degree of moisture may be obtained by adding to any quantity of quite dry earth from one-half to one-eighth of its weight of water, in such manner as to thoroughly incorporate it.

To make the wall, only so much earth must be put between the moulds at once as will form a layer of three or four inches deep, which is to be rammed hard with a rammer of hard wood, the head of which is directed to be made circular, and swelling to the middle,

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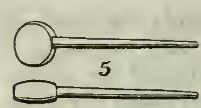
* It appears to me that it would be much better to have two pair of moulds, and to fit them up to each corner, embracing both sides in succession, which would form the corner more easily and completely, and more hands could in this manner be employed in ramming up. J. D. B.



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(fig. 5,*) and into this a suitable handle is inserted. The first strokes of the rammer should be made close to the side and then applied to every part of the surface. Several workmen may be employed in ramming one mould, each ramming his own division, and then crossing the stroke under the rope, so that the earth will be pressed in every direction: care must be taken that no fresh earth is received into the moulds until the first layer is thoroughly rammed, which is ascertained when the stroke of the rammer leaves hardly any print. Proceed in this manner till the mould is full, the braces are then slackened, the bottom piece drawn out, and the mould and frame removed to the next corner, when proceed as before. Observe, however, in placing the moulds, so to arrange or vary them, in opposite directions in each succeeding corner, that the joinings near the middle of each side of the wall shall not be perpendicular, but vary a foot or more in each layer, (fig. 6.) The joinings will not then be perceptible, and the wall will be rendered stronger. The holes left by the bottom pieces of the frame are to be filled up, and rammed when the wall is up.

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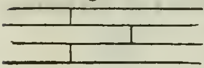

Of the proper kinds of earth.—It is stated that, 1st, all earths in general are fit for use when they have not the lightness of poor land, nor the stiffness of clay. 2nd, all earths fit for vegetation. 3d, strong earths mixed with small gravel, with which the best work is done. Experience proves that so soon as the wall is made, the heaviest beams and rafters may be placed on them without danger. The gable end may also be made of earth wall.†

The door and window frames must be set in as the work progresses, they are made of one and a half or two inch plank, of a width to correspond with the thickness of the wall: the rebates and grooves for the doors, window sashes, and shutters, can be formed in the frames when made, or it may be done by mouldings after the walls are built. Strips of plank must be nailed all around on the outside of the frames to secure them firm in the wall. To bind the walls more strongly, at about every two feet of rise, strips of plank, split sticks, or laths, six or eight feet long, are laid lengthwise, but not nearer to the outside of the wall than two inches, that they may be hid; between these is a layer of the same material, eight or nine inches long, and laid across the wall for the same purposes. Walls built in this manner, of proper earth, are so substantial that the plates, rafters, and roofs, of the heaviest kind, may be immediately put on without danger.‡

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* The form of the rammer is said to be very important; this I doubt. The weight, I believe, is not stated. I think the rammers used in iron foundries would answer perfectly well, viz. a flat iron head of about three pounds weight, to ram close to the moulds in the first place, and then a round iron head of about six pounds, to go over the whole.

† I apprehend it would be adviseable, until experience is gained, for them to be made with studs, and weather-boarded, in the usual way.

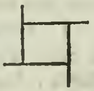
‡ Floors made by ramming earth in the same manner and raised about a foot

Remarks on the foregoing plan of Building Earth Walls for Cottages. By J. D. B.

Its adoption will be a great saving in rural economy where lumber and bricks are dear, or cannot be had; and would be preferable to log cabins in new settlements; such, however, is the force of habit that it will not supersede them; but I have made the above extracts with a view specially to the Liberian Colony, where the timber is not suitable for plank, and lumber for building is mostly imported, and is, of course, very expensive, and stone, or brick walls, equally or more so; and it is of great importance that new settlers, especially farmers, should be cheaply, readily, and comfortably accommodated. These benefits are all united in this plan. It is believed that half a dozen men would, after due preparations, ram up the walls of a cottage eighteen feet square, in two days; and as the natives are already versed in building huts of clay, the change will not be so great to them, but that they might be employed in this mode of building, and probably they would adopt it, as one of the earliest steps toward their civilization.

The only difficulty I apprehend in the execution of the work is, in so adjusting the moulds when drawn up, as to form and preserve the walls truly perpendicular, and with the intended *batter*, or taper. This will require as correct workmanship as in laying a brick wall. To obviate this difficulty, and put the business within the ability of common workmen, I will propose as a substitute for the moulding board a method that has occurred to me as simple and requiring very little skill, and which may, perhaps, be in other respects preferable—it is this:

The foundation being built, as above directed, of stone or brick, plant posts strongly in the ground on both sides of the foundation, three or four feet apart, in the direction of the walls, and higher than they are to rise. These posts must be in opposite pairs, stiff, and dressed straight on the inner sides, allowing as much space on each side of the foundation as merely to admit the plank, or board, used in the construction, by this mode, to be slipped, or driven, into the spaces. These boards may be of common inch, or inch and quarter, pine, but all used on any one side must be of equal thickness, and all with straight and fair edges and ends. They are to be placed inside of the posts, edge upon edge, as the wall is rammed up, one above another from bottom to top. The plank forming the interior must be cut of lengths to reach exactly from corner, on the outside their ends may project thus—



The posts are secured at top to allow just the space for the thickness of the wall, and of the planks on each side, by tenons made on the posts, over which braces, or gauges, with

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above the level, will doubtless be dry, comfortable, and as healthy as brick pavement.

When the walls have become dry, which will require several months, they may be whitewashed with lime, or rough-cast in the usual way, and will then appear as handsome as any stuccoed wall.

mortices, are placed and secured by wedges on the outer sides. When the wall is made, the wedges being driven out, the gauges, planks, and posts, may be successively removed, and the wall is completed. The only difficulty I anticipate in this process, will be in planting the posts exactly in true lines. This, however, I think may be effected by first planting the posts nearest to each corner in correct positions; then fixing the braces on them at top and dropping upon them thick plank of such width as to fill up the space between the posts, which plank will then regulate the tops of all the posts that remain to be set up.

For a single building this plan might be more expensive than the first described, but where a number of houses are to be built, as the same posts and boards will answer for all of them, I believe it would be cheapest, easiest, and certainly best, where good mechanics are wanting.

In putting on the roof it will be prudent to give the eaves a bold projection, to secure the walls from the effects of rain, and also to put a weather, or wash, board in a sloping position, across the ends of the house (from eve to eve,) for the same purpose.

Nothing yet has been said in regard to chimnies. I presume when brick work is easily procured, it may be best to build the chimney therewith when the foundation is laid; but in Liberia, if wanted at all, the fire-place may be built of brick or stone, and the chimney be formed of clay like the native huts, and outside of the wall; similar to the plan pursued with log houses in this country.

FRANKLIN INSTITUTE.

Continuation of the Report of the Committee of the Franklin Institute of Pennsylvania, appointed May, 1829, *to ascertain, by experiment, the value of Water as a Moving Power.*

(Continued from p. 16.)

WHEEL No. IV.

This wheel, six feet in diameter, was substituted for No. III. The barreling of the shaft was removed, and the chain, which supported the weights raised, wound directly upon the axis. The iron basket, used in former experiments to contain the weights, was also removed, and the weights were applied directly, by hooks, to the chain.

To ascertain the amount of friction at the gudgeons of the wheel, a cord was wound around the axle, and weights applied until a uniform velocity, of six feet per second, was maintained in the periphery of the wheel, by the descent of the weights. The weight of the wheel was twelve hundred pounds, and seventeen and four-tenths pounds maintained a velocity of six feet per second. The friction was therefore nearly one and a half per cent, (1.45) of the weight. One per cent of the weight applied was, as before, the ratio of friction upon the gudgeons of the drum.

The rate of friction being different in the wheel and drum, the calculations relating to it are less conveniently made than in the former cases. The principle upon which they are made is, however, still simple and obvious. When any weight is applied to the chain and raised by the wheel, the gudgeons of the drum support the tension of both the parts of the chain, viz. that between the drum and the weight, and that between the drum and the wheel; the pressure upon the axis of the drum is therefore twice the weight raised. The rate of friction upon this is one per cent.

The tension of the part of the chain between the drum and wheel, the chain being very nearly vertical, relieves the gudgeons of the wheel of a weight equivalent to that tension; that is, to the weight applied to the other end of the chain. The friction upon this weight, at one and a half per cent., is therefore to be deducted from the friction due to the weight of the wheel.

The following calculations are made in accordance with the principles just stated.

Constant *inactive* weight.			
Weight of the wheel,	1200 lbs.		
Friction given by experiment,			17.40 lbs.
Average weight of the chain wound around the axle of the water wheel,	80 ,,		
Friction at one and a half per cent.,			1.20 ,,
Weight of the drum,	200 ,,		
Friction at one per cent.			2.00 ,,
Weight of the chain borne by the gudgeons of the drum,	184 ,,		
Friction at one per cent.,			1.84 ,,
Friction due to constant *inactive* weight,			22.44 lbs.
Constant *resisting* weight.			
Weight of the chain between the shaft and the ground,	20 lbs.		
One piece of lead,	9 ,,		
Sum,	29 lbs.		
Pressure upon the gudgeons of the drum due to 29 lbs.,	58 lbs.		
Friction at one per cent.,		.58 lb.	
Gudgeons of the wheel relieved from,	29 ,,		
Friction at one and a half per cent.,		.43 ,,	
Difference,		.15 lb.	
Friction, carried out,			.15 lb.

The centre of gravity of the wheel when loaded was 1.75 feet from the axis, the chain was .5 ft. from the same axis; hence to raise 29 lbs. and overcome a friction of (22.44 +

.15) 22.59 lbs. required a weight of water of 14.74 lbs. The friction upon this at one and a half per cent. is - - - - .22 lb.

Total friction when a weight of 29 lbs. was raised, - - - - 22.81 lbs.

To determine the friction due to a weight added, as, for example, to 56 lbs. we have—

Pressure upon gudgeons of drum, -	112 lbs.	
Friction at one per cent., - -		1.12 lb.
Gudgeons of wheel relieved from -	56 ,,	
Friction at one and a half per cent. -		.84 ,,
Difference, - - - -		.28 lb.

To balance 56 lbs. and overcome a friction of .28 lb. required, of water, 16.08 lbs. The friction upon this at one and a half per cent. is - - - - .24 lb.

Total friction for 56 lbs. additional weight, .52 lb.

The details in relation to wheel No. IV, are as follow:

The diameter of the wheel six feet; the breadth twenty inches, or sixteen inches between the cants; cants six inches deep.

Advantage was taken of the very manageable size of this wheel to experiment upon various forms of buckets. The varieties are figured on Plate VIII, figures 1, 2, 3, 4, 5. Fig. 1 shows the form and dimensions of the first variety of elbow buckets: in these the width of the elbow was three inches, and the opening at the throat two inches; the number of buckets twenty. Fig. 2 represents the second variety of elbow buckets; the width of elbow, as before, three inches, and opening of the throat two inches, the number of buckets forty. Fig. 3 gives the form of the oblique buckets next affixed to the wheel; the face of each bucket made an angle of thirty degrees with the tangent to the wheel at the point at which the bucket was placed; they differ, therefore, from the oblique buckets which were used with wheel No. I. There were thirty of these buckets around the wheel. Figs. 4 and 5 show the two forms of curved buckets which were made the subjects of experiment. The lines upon which the curved buckets of fig. 4 were traced (see *a b* fig. 4, Plate VIII.) made angles of twelve degrees with the tangents at the several points at which the buckets were placed, thus representing very oblique buckets; on these lines the buckets were traced by the following method, which is given for a single bucket. The width of throat being fixed at two inches, a circular arc was traced through *a*, tangent to a circle of two inches and a half radius, and described with the centre *b;* thus the proper width of throat, allowing for the thickness of the boards forming the buckets, was secured; to this circular arc a line *d e*, being drawn tangent, completed the form of the bucket.

After the buckets just described had been made the subjects of experiment, the straight line part was cut away until the throat was widened to three and one-eighth inches, giving the bucket shown in fig. 5. In this case a more easy escape was provided for the air, and, of course, a more free access permitted to the water.

It was not deemed necessary to add to the already prolonged labours of the committee, by repeating the excellent experiments of Poncelet on the application of curved buckets to undershot wheels.

This wheel was used only as an overshot wheel; the breast, when used, extended to the level of the centre of the wheel. The gate generally used in the experiments with this wheel is shown in fig. 1 of Plate VIII, in which *a* is the chute, and *b* the sliding gate, which in the figure is closed; by drawing this gate to the right, the chute was opened, and the water delivered between the projection *c* and the side *d* of the chute.

To ascertain the relative effect of water when issuing under a head upon the wheel, and when taken from the surface, by being allowed to flow over a gate, the form of gate given in fig. 6, Plate VIII. was used. An opening, *a b*, was made in the bottom of the forebay, to one side of which the hinged gate *c* was attached, the hinge being at *a;* the gate was moved by the stem *d.* When the face was vertical, as shown by the full lines in the figure, the gate prevented the water from passing to the wheel; when inclined, as shown by the dotted lines, the water, which was kept at a constant level in the forebay, flowed over the surface of the gate and fell upon the wheel. In using this gate the direction of the motion of the wheel was reversed, and there was no breast.

The experiments made with wheel No. IV. will be given in five tables. Table 1, parts I and II, will contain the results of trial with the forty elbow buckets (fig. 2, plate VIII;) table 2, parts I, II and III, those with the twenty elbow buckets, (fig. 1, Plate VIII;) table 3, parts I, II and III, those with the thirty oblique buckets, (fig. 3, Plate VIII;) and table 4, those with the curved buckets of fig. 4 Plate VIII; and table 5, those with the curved buckets of fig. 5, of the same plate. The experiments with the gate of fig. 6, Plate VIII, were made with the curved buckets of fig. 5, and are included in the table 5 with those made with the same buckets and the gate of fig. 1.

The tables now to be given complete those containing the record of the experimental researches of the committee in relation to water wheels. Circumstances prevented the committee from taking up the subject of the reaction wheel, to which they alluded in the commencement of this report.

TABLE 1.—PART I.

Wheel No. IV. 40 Elbow buckets. Close breast. Water let on at upper centre of wheel.

No. of Exper't.	Head of water above.			Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.															
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Seds.	Feet.	Pds.	Feet.						
1	0.25	0.50	1.00	0.50	29	22.81	51.81	40.0	36½	5.94	350	6.50	22750	20724	.911	.911	5.94	
2					43	22.94	65.94		49	4.43	470		30550	26376	.863			
3					57	23.07	80.07		55	3.93	585		38025	32028	.842			
4					71	23.20	94.20		73	2.97	720		46800	37680	.805			
5				1.00	43	22.94	65.94		29½	7.35	500		32500	26376	.812			
6					57	23.07	80.07		35	6.20	600		39000	32028	.821			
7					71	23.20	94.20		41	5.29	680		44200	37680	.852	.852	5.29	
8					85	23.33	108.33		48½	4.47	815		52975	43332	.818			
9					99	23.46	122.46		57	3.80	930		60450	48984	.810			
10				1.25	57	23.07	80.07		30½	7.11	630		40950	32028	.782			
11					71	23.20	94.20		36½	5.94	720		46800	37680	.805			
12					85	23.33	108.33		41½	5.22	800		52000	43332	.833	.833	5.22	
13					99	23.46	122.46		47	4.61	920		59800	48984	.819			
14					113	23.59	136.59		49	4.43	1035		67275	54636	.812			
15					127	23.72	150.72		59	3.67	1145		74425	60288	.810			
16				1.50	85	23.33	108.33		34½	6.29	835		54275	43332	.798	.798	6.29	
17					99	23.46	122.46		39½	5.49	950		61750	48984	.793			
18					113	23.59	136.59		46½	4.67	1080		70200	54636	.778			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

Plate VIII.

Fig. 1.

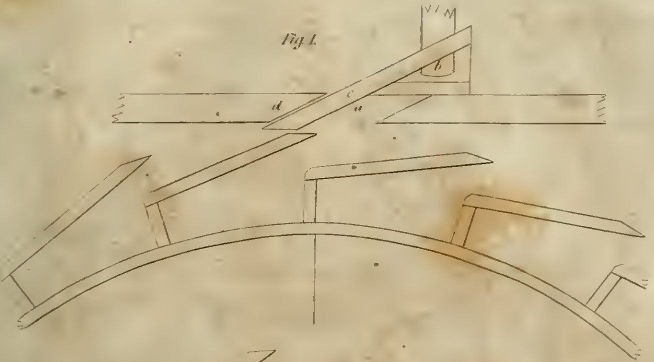


Fig. 2.

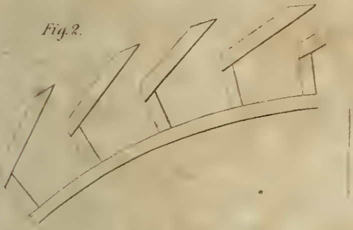


Fig. 3.

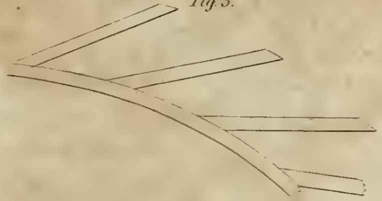


Fig. 5.

Fig. 4.

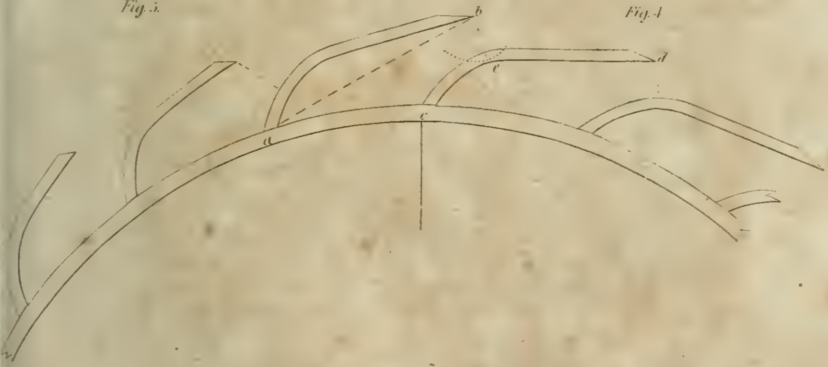
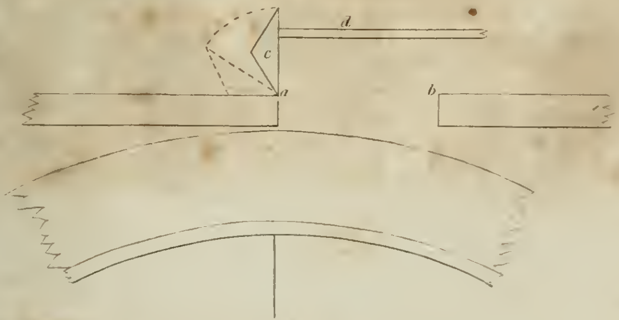


Fig. 6.



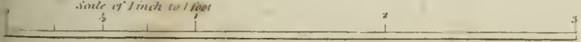


TABLE 1.—PART II.

WHEEL No. IV.—40 *Elbow buckets. Close breast. Water let on at upper centre of wheel.*

No. of Exper't.	Head of water above.			Width of aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wtofwater expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.															
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
19	0.25	0.50	1.00	1.75	85	23.33	108.33	40.0	31½	7.11	955	6.50	62075	43332	.698			
20					99	23.46	122.46		38½	5.64	1075		69875	48984	.701			
21					113	23.59	136.59		39½	5.49	1150		74750	54636	.731	.731	5.49	
22					127	23.72	150.72		46	4.71	1280		83200	60288	.724			
23					146	23.90	169.90		51½	4.23	1355		88075	60288	.684			
24	0.75	1.00	1.50	0.38	85	23.33	108.33	40.0	34½	6.29	795	7.00	55650	43332	.779			
25					99	23.46	122.46		43	5.03	880		61600	48984	.795	.795	5.03	
26					113	23.59	136.59		45½	4.75	995		69650	54636	.784			
27				0.75	113	23.59	136.59		39	5.57	975		68250	54636	.801	.801	5.57	
28					127	23.72	150.72		45½	4.75	1085		75950	60288	.794			
29					138	23.83	161.83		51	4.29	1175		82250	64728	.787			
30				1.00	138	23.83	161.83		35	6.20	1255		87850	64728	.737			
31					146	23.90	169.90		36	6.03	1320		92400	67960	.735			
32					160	24.03	184.03		38½	5.64	1400		98000	73612	.751			
33					174	24.16	198.16		40½	5.35	1600		105000	79264	.755	.755	5.35	
34				1.25	174	24.16	198.16		41½	5.22	1525		106750	79264	.743			
35					184	24.25	208.25		39½	5.49	1590		111300	83300	.748	.748	5.49	
36					198	24.39	222.39		40½	5.35	1705		119350	88956	.746			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE 2.--PART I.

WHEEL No. IV.—20 *Elbow buckets. Close breast. Water let on at upper centre of wheel.*

No. of Expert'l.	Head of water above.			Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.															
	Feet.	Feet.	Feet.	In.	Pds.	Pds.	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
1	0.25	0.50	1.00	0.50	30	22.82	52.82	40.0	37	5.86	375	6.50	24375	21128	.867	.867	5.86	
2					41	22.92	63.92		49	4.43	465		30225	25568	.846			
3					44	22.95	66.95		49	4.43	490		31850	26780	.841			
4					58	23.08	81.08		62	3.50	605		39325	32432	.825			
5				0.75	44	22.95	66.95		37½	5.78	500		32500	26780	.824	.824	5.78	
6					58	23.08	81.08		46½	4.67	615		39975	32432	.811			
7					72	23.21	95.21		57	3.80	730		47450	38084	.803			
8				1.00	44	22.95	66.95		33	6.57	555		36075	26780	.742			
9					58	23.08	81.08		38	5.71	665		43225	32432	.750	.750	5.71	
10					72	23.21	95.21		46	4.71	805		52325	38084	.728			
11					86	23.34	109.34		59½	3.64	950		61750	43736	.708			
12				1.50	58	23.08	81.08		30½	7.11	740		48100	32432	.674			
13					72	23.21	95.21		33	6.57	800		52000	38084	.732			
14					86	23.34	109.34		38	5.71	910		59150	43736	.739	.739	5.71	
15					100	23.47	123.47		44	4.90	1040		67600	49388	.731			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE 2.—PART II.

WHEEL No. IV.—20 *Elbow buckets. Close breast. Water let on at upper centre of wheel.*

No. of Exper't.	Head of Water above. Btm. of gate.	Head of Water above. Top of bkt.	Head of Water above. Btm. of bkt.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
16	0.75	1.00	1.50	0.38	44	22.95	66.95	40.0	31½	6.89	470	7.00	32900	26780	.814			
17					58	23.08	81.08		36½	5.94	550		38500	32432	.842	.842	5.94	
18					72	23.21	95.21		43½	4.96	675		47250	38084	.806			
19				0.50	58	23.08	81.08		32½	6.67	585		40950	32432	.792			
20					72	23.21	95.21		37	5.86	680		47600	38084	.800	.800	5.86	
21					86	23.34	109.34		43½	4.96	800		56000	43736	.781			
22					100	23.47	123.47		54	4.00	925		64750	49388	.763			
23					114	23.60	137.60		58	3.74	1045		73150	55040	.752			
24					133	23.78	156.78		55	3.93	1245		87150	62712	.720			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE 2.—PART III.

WHEEL NO. IV.—20 *Elbow buckets. Close breast. Water let on at upper centre of wheel.*

No. of Expert'.	Head of water above.			Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.															
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
25	2.75	3.00	3.50	0.17	58	23.08	81.08	40.0	25½	8.51	645	9.00	58050	32432	.559			
26					72	23.21	95.21		27	8.03	665		59850	38084	.636			
27					86	23.34	109.34		30½	7.11	730		65700	43736	.665	.665	7.11	
28					100	23.47	123.47		35	6.20	825		74250	49388	.665			
29					114	23.60	137.60		37	5.86	930		83700	55040	.657			
30					128	23.78	151.73		37½	5.78	1045		94050	60692	.645			
31				0.25	58	23.08	81.08		22	9.86	925		83250	32432	.390			
32					86	23.34	109.34		24	9.04	1005		90450	43736	.484			
33					114	23.60	137.60		26	8.34	1105		99450	55040	.553			
34					161	24.04	185.04		30½	7.11	1335		120150	74016	.616			
35					189	24.30	213.30		35	6.20	1520		136800	85320	.624	.624	6.20	
36					217	24.56	241.56		38½	5.64	1730		155700	96624	.620			
37					231	24.69	255.69		42½	5.09	1830		164700	102276	.620			
38	3.75	4.00	4.50	0.12	58	23.08	81.08	40.0	25½	8.51	600	10.00	60000	32432	.540			
39					72	23.21	95.21		30	7.23	630		63000	38084	.604	.604	7.23	
40					100	23.47	123.47		40	5.42	845		84500	49388	.584			
41					114	23.60	137.60		42	5.16	960		96000	55040	.573			
42					133	23.78	156.78		45½	4.75	1100		110000	627120	.570			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

[TO BE CONTINUED.]

ANALYSIS OF THE REPORT, &C. ON STEAM CARRIAGES.

Report on Steam Carriages by a Committee of the House of Commons of Great Britain. With the minutes of Evidence, and Appendix. Reprinted by order of the House of Representatives of the United States. (1832.)

(Continued from p. 273.)

"You have stated that you think the bringing of these machines to perfection is retarded, because there is not a sufficient prospect of encouragement, and that steam coaches are therefore confined to the hands of persons who have not the same skill in practical mechanics as others, who would undertake the subject if adequate encouragement were offered; can you point out any mode by which that encouragement could be given? Nothing could do it so effectually as offering a handsome parliamentary reward for the attainment of some specified performance, such as keeping a steam coach for passengers regularly plying on some suitable road for two years, during which it should not have failed to arrive by steam more than some specified number of times, and within a certain number of hours of lost time from the time-bill of the mail on the same road. Suppose this were done between London and Bristol, for a reward of £10,000, it would cost the public nothing if it were not accomplished, and the establishment of that one coach to carry the mail would be worth the money to the public whenever it was accomplished: or between London and Holyhead would be still more important, but that would require £20,000 reward. Another plan of more immediate application would be to offer a bounty of a fair price per mile for carrying despatches by steam (as I suggested before) whenever they arrive in a specified time; the price should be sufficient to pay expenses. That would, I think, be the best course, because I believe it would be undertaken at once by individuals, provided that no stipulations were made either for or against carrying passengers or goods. They would be sure to carry passengers and goods as soon as they could, for their own profit; and it might be stipulated, that after any coach had earned a certain sum in bounty, it should not be entitled to more. The effect of such public rewards has been very striking in the case of the invention of means of ascertaining the longitude at sea. Another way would be, instead of money, to give exclusive privileges for a term to any persons who should first succeed in establishing steam coaches on specified roads, under specified conditions of performance; or a society offering a premium, as was done in the case of steam navigation to India, would have a good effect: as was also shown in the case of the locomotive steam carriages on the rail-way between Liverpool and Manchester. There a most inadequate premium (only £500,) brought the invention forward more than ten following years of desultory and unencouraged attempts would have done."

"You think those means would produce a great effect? I have no doubt of it; an important result may often be within a moderate sum of attainment, and yet a prudent man will not set about it. It will be certain to cost £1,000 and a year's hard labour of an engineer, whose time is worth £500 more, to make a new steam carriage in a proper manner and bring it to bear as a business, supposing that its performance turns out as near to previous calculation, according to the experimental coaches now in existence, as can be expected, and that no radical alterations require to be afterwards made in it. After succeeding in the attempt, he must expect to make copies of it on the same terms as other makers, who would examine one of the first coaches he sends out, and copy it with very little trouble. The operations of competent mechanicians in making first machines of new invention, and bringing them to perfection in all their details, are necessarily more expensive than those of first inventors, who execute their experimental machines in a slovenly manner with cheap workmanship only as experiments; but when those experiments have been gone through, an extreme soundness and accuracy of workmanship is the only chance of attaining success in the machines which are sent out for real business. For want of experience to direct the mechanician as to the right form, dimensions, and weight, of each piece of his machine, it often happens that, after having made a piece of expensive work, it will prove too slight or too heavy when set to work, and he may have to make it over again as expensively. The copyists who will afterwards come into competition with him when his machine is brought to bear, will have no such difficulties."

"You conceive that a grant of public money as a premium would call forth the necessary degree of skill? I have no doubt of it; we have had very few instances of invention being stimulated by the offer of public reward; but the instances, ascertaining the longitude is a most brilliant example. The facility and accuracy with which the longitude is now determined at sea, is the result of one of the greatest efforts of human genius and perseverance. The stimulus of reward has occasioned both modes of it to be perfected, viz. by astronomical observations and by time-keepers. We should very soon have steam carriages brought into full use if such a reward were offered."

"Have you ever ascertained the duty or performance of work done in respect to the fuel consumed by locomotive engines? They vary so greatly, that it is difficult to make a statement. The common locomotive engines which have been used for several years to draw coal wagons on rail-ways, have remained without material improvement for a long time, and their performance is very low, being only equal to raising about four millions pounds weight one foot high by the consumption of a bushel of coals, their boilers evaporating about four cubic feet and a half of water into steam with each bushel of coals. Such engines exert six to eight horse power. Mr. Stephenson's new quick-going engines on the Liverpool and Manchester rail-way are more improved in duty, and are in a progressive course of improvement; but as they burn coke instead of coal, the established mode of computation is inapplicable. Mr. Stephenson's small engine, called the Rocket, which gained the prize of £500, offered by the Liverpool and Manchester rail-way company, and which was the model for succeeding engines, exerted about six horse power during that trial, and burned 177 lbs. of coke per hour, which is at the rate of about five millions and a half pounds weight, raised one foot high by the consumption of eighty-four pounds of coal; but they have greatly reduced the consumption of fuel in the succeeding engines on that rail-way, owing to enclosing the cylinders of the engines within the lower part of the chimney, were they kept very hot, and an increased effect has been given to the fire by blowing the waste steam upwards through the chimney, as I stated before. In the Rocket they were just beginning to be aware of the value of that expedient for animating the fire, and it was done in a degree, but it has been since done more completely."

"Do you know how near any part of the rail-road between Manchester and Liverpool runs to the common road?—I cannot say; in passing along the railway, I do not recollect seeing the turnpike road, except crossing it several times."

"The noise made by the engines used on the rail-way is much greater than by the steam coaches, is it not? Yes; Mr. Hancock's coach makes less noise than any of Mr. Stephenson's engines; but the power exerted by the latter is much greater than by Mr. Hancock's engines. The quick travelling carriages on the Manchester and Liverpool rail-way, when drawn by the last improved engines, are extremely easy in their motion."

"Is it your opinion that a road would suffer less injury from the fore and hind wheels of a steam carriage following each other, in the same tracks on the road, than if they run on different tracks? That depends upon what kind of action the wheels exert on the road; if they cut it up and disturb the materials, by pressing down some stones so deep as to displace other stones sideways, and cause them to rise up at the sides of the track, then it is best not to allow such wheels to cut the road twice in the same places; but if the fore wheels roll the road smooth on the surface, and consolidate, without disturbing, the materials; that is, if they only press down the stones over which they pass as much as will produce a close contact, but not so much as to displace the neighbouring stones laterally, then I think the hinder wheels should follow in the tracks of the fore wheels; certainly that is best for the carriage; and I believe it will be found that it makes but little difference to a good hard road whether the four wheels of a carriage follow in the same track or not, provided that the wheels are not loaded so as to indent deeply into the solid materials of the road. All carriages ought to have their wheels of such a breadth that they will not leave any material indentations in the road. They should rather consolidate the materials than break them up. If the fore wheels are only so much loaded, in proportion to their breadth and to the hardness of the road materials, that they will consolidate the materials over which they have passed, then I think it is quite as well for the road, and much easier for the carriage, that the hind wheels should follow in the tracks of the fore wheels. The loading of the carriage may be so arranged that the principal weight will be borne on the hind wheels, and the fore wheels may (by a suitable apportionment of breadth) be qualified to consolidate the road in their tracks, and thus prepare the way for the passage of the hind wheels, with the least wear of the road and the greatest ease to the carriage. It is quite as much the interest of the proprietors of carriages, as of the road trusts, that the roads should not be cut up by too narrow wheels, for it is always at the expense of horse labour that the road is thus injured, independently of the evil of having a worse road to travel over the next time. If the wheels are too narrow for the load upon them, and the road materials soft, so that the wheels do print tracks in the road, that evil will be greater, if the hind wheels follow the fore wheels than if they run in new paths; but it is better to remove the evil, by using broader wheels or less load, or harder road materials, and to run the wheels in the same tracks; because the resistance to a carriage is, in all cases, increased by running the wheels in different tracks, and that with little or no benefit to the road; particularly when the road is covered with mud and wet dirt, or snow. The above observations apply to all four wheeled carriages, whether they are drawn by horses or impelled by steam; but, in common carriages, the horses' feet tend to dig up the road. I think the steam carriages will, when perfected, be free from that objection, and that they have a greater claim to be allowed to run their wheels in the same tracks than other carriages.

"Were you ever in Mr. Hancock's carriage when travelling? Yes; I have ridden on it; but he has put in larger cylinders since I went with him the last time, and I understand makes better progress now. I have examined all his present machinery in detail, and think it very judiciously planned."

"Did you find that it frightened horses, or annoyed passengers? I have stated before, that I found horses were not frightened; but every one must judge for himself of the degree of annoyance he experiences. Persons who are accustomed to travel in luxurious private carriages, would find many annoyances in a common stage coach, which others would consider as excellent travelling. I am so accustomed to machinery, and to stage coach travelling, and to steamboats, that I am not liable to be annoyed thereby; and I found riding in Mr. Hancock's carriage to be exceedingly like travelling in a stage coach. I heard no complaints by passengers. I believe he has never found any difficulty in getting passengers, since he has run for hire. Persons are reported to be annoyed by the smell of hot grease, in the steam coaches on the Cheltenham road; I can only say, that I never observed such a smell in Mr. Hancock's carriage. If there are any real annoyances to the passengers in particular steam coaches, they will work their own cure in a short time, either by the proprietors finding out remedies, or else giving up their coaches, as they must do if they are not rendered agreeable to the passengers. The only question that deserves attention is, whether there is any danger to passengers, or any serious annoyance to other persons not passengers."

"Did you observe any horses or carriages passing his carriage? Yes, I have always passed through crowds of horses and carriages with all the steam coaches I have tried; there is so much curiosity excited by the novelty of a steam coach in motion, that all the horses on the road are drawn up to get a sight of it, and many are turned to follow after it. I have observed that some horses take very little notice of the steam coach; others are a little startled, but I never saw any difficulty which the reins could not control with the greatest ease. Horses are easily alarmed at any thing unusual, but they very soon become accustomed to any thing, as is shown by the readiness with which horses can be brought to endure discharges of fire arms and of artillery. A patent was taken out some years ago for what was called a travelling Advertiser; it was a small four wheeled carriage, supporting an enormous octagonal tower, which was stuck all over the outside with printed bills for advertisements. It was drawn very slowly through the streets by one horse, and had a most unusual appearance: this machine was indicted as a nuisance because it frightened horses."

"Have you never observed horses to shy at a stage coach when heavily laden? I have observed horses to be alarmed at the enormous bulk which some of the vans carry at times at a great height above the ground. Horses are the most timid animals to encounter every thing that they are not accustomed to, and the most courageous animals to encounter every thing that they are accustomed to, even when really terrific, such as discharges of fire arms."

"Had you occasion to turn any sharp corners when in Mr. Hancock's carriage? Yes, many; the yard of his premises is exceedingly narrow and inconvenient to turn into and out from, but it is done with ease by the steam coach; the same place would not do at all for a coach and four horses to put up at."

"Going at what speed can you turn round a sharp corner without any danger? I do not remember turning with any considerable speed, nor should it ever be attempted with any carriage if it can be avoided, and there can be no necessity or pretence for going quick when turning a steam coach, as its power is quite controllable, in which respect it has a great advantage over a common carriage; for four horses at the moment of turning, are very little under the control of the reins, particularly the leaders, and it depends upon their good will whether they choose to go slow or go quick when turning. In a steam carriage, the conductor has such a perfect control of the power, that he can never fail in checking the speed at the moment of turning. I observed that Mr. Hancock's carriage is steered with the greatest case, and will turn round in a very short space: I have seen him turn round in the new road to return without backing the carriage at all, although he was in the middle of the road when he began to turn."

"If you had turned a sharp corner, could you have stopped immediately on meeting a carriage? Yes; the power of stoppage is most remarkable: that is one of the great advantages of a steam coach. I have steered Mr. Hancock's carriage myself, and found it to be most completely under control."

"The carriage may be turned in the smallest space that the wheels will permit it to go round in? Yes, in a much smaller space than a carriage with horses can turn, because it is so much shorter in the total length, and the power being completely under control, there is no danger in turning quite short; whereas no prudent driver will turn a four horse coach round in a road, without the guard getting down and holding the leaders' heads; for they are not sufficiently under the control of the reins in turning to do it with safety."

"Did you ever see a steam carriage going down a hill? Yes, down the hill of the new road at Islington; and it was done with more safety than with any carriage with four horses; but I do not contemplate the descent of steam coaches down very steep hills, for that supposes their getting up such hills, which is not likely to be accomplished soon, and the present coaches seem to me to be only fit for our most improved lines of roads, where all very steep hills have been reduced to moderate slopes.

"Have you turned your attention particularly to the subject of going up steep hills, and what ascent do you think can be surmounted? In forming my opinion of the probability that steam carriages will be brought to bear, I could not overlook the circumstance that they would have to go up and down hills; but most of our great lines of roads are now so improved, that what were formerly called steep hills are not very numerous or frequent; but wherever they do occur, I propose to give the steam coach the assistance of a pair of post horses in aid of its own power. In going down hill, steam coaches are very safe, because the whole power can be effectually exerted to retard or resist the turning of the wheels."

"Mr. Gurney's steam coach has gone up Highgate hill without horses? Yes, but I understood that it was broken in pieces in coming down again. My objection to attempting to make a steam coach go up a steep hill, in the present state of our knowledge, is, that it requires to have a great strength, and consequent weight of machinery to have a sufficient power to do so with safety, and which weight is a useless incumbrance and impediment to progression at all other times. The question is, whether all the machinery of a steam carriage should be made twice as strong and heavy as is necessary for impelling it with safety on a tolerably level road, merely that it may have power within itself for going up a few occasional hills, or whether it is better to make the machinery lighter, and take the occasional assistance of a pair of post horses? There can be no objection to the latter expedient, except the expense of such horses; and as the steam coach can carry goods to profit in place of all the weight of machinery which is saved by making it lighter, I think that the aid of post horses would be an economy. In forming such an opinion, I have followed a maxim which I had always found to hold true; viz. that steam power is certain to be more profitable than horses, if the work is to be kept constantly going on, because then the great advantage of steam power, that it does not tire, becomes fully available; and to perform the same service by horses, a very great number must be kept for change; but for business which requires only occasional working, or for working during only as many hours each day as horses can do without changing, steam power loses its great advantage over horses, and in some cases they will do the work cheaper. One great item of the expense of steam power is the first cost of machinery and engineers' wages; both which would be only the same for working twelve hours per day, as for one hour and a half, which is the utmost that a stage coach horse can draw at ten miles an hour. A steam coach should work twelve or fourteen hours in every twenty-four hours, to gain the full advantage of the system of steam power over horse labour; the intervening ten or twelve hours will allow ample time for putting every thing in perfect order for the next journey, if the machinery is what it ought to be, and there should be a spare coach for every two which are running, to allow time for more considerable repairs: hence, I reckon that three steam coaches should keep up a double passage of 100 or 120 miles a day continually. Expensive machinery, which is only to be worked occasionally, will not, in some cases, do work so cheap as it can be done by men or by horses without machinery; and that I conceive to be the case with the extra cost, weight, strength, and complication, which must be given to the machinery of a steam coach, in order to enable it to go safely up steep hills without assistance. I apply these remarks to the present steam coaches, but future improvements may in time produce that species of machinery which will effect the going up hill with less difficulty than the present. It has been supposed that the diameters of the cylinders being larger than is necessary for going on level ground, they could be worked with a diminished strength of steam to go on level ground, and stronger steam when going up hill. To get up ordinary and moderate hills, that is certainly the right plan; but it requires the strength of all the moving parts of the engines to be made sufficient to bear the utmost force that the pistons can exert when impelled by the strongest steam that is ever to be used; also, the large wheels which run upon the road should be made very broad on the edges, and of proportionate strength. The present coaches have been faulty in these respects, and yet the machinery is too heavy. Another way of getting sufficient power to go up hill is to have the pistons only a suitable size for going along the ordinary road, and to introduce wheel work, which can be thrown into action when a hill is to be ascended, and which will turn the wheels of the carriage round only once for three turns of the cranks of the engine, and consequently with a triple force. Mr. Hancock has shown me the parts of such machinery which he is now making for a new steam coach, with wheel work and endless chains, on a plan which I think very likely to answer for ascending moderate hills; but for very steep hills, I think it is desirable to have the help of post horses. The immediate desideratum is, to construct a steam coach with the power and strength necessary to go quickly and safely along the best lines of road which can be found, without any steep hills upon them, taking the assistance of post horses where it is necessary. If that is accomplished, and such a coach is worked continually for two or three years, it would probably lead to the knowledge of the proper kind of machinery to go up steeper hills; but if the adoption of steam coaches is to wait until they are rendered much more perfect, it will be a very long time, because practice is essential to finding out a proper plan."

"Do you think there is any danger in going down a hill in a steam carriage? Much less than in a common stage coach, for by backing the engines, so that their power is brought to act in opposition to the turning round of the wheels, and with the assistance of drags, or brakes, to rub on the rims of the wheels, and aid in retarding their motion by friction, steam coaches will safely go down all moderate hills, such as are met with on our best lines of turnpike roads, say between London and Holyhead; and with machinery such as Mr. Hancock is now making, if it is suitably proportioned, I expect a steam coach would not require assistance to get up a hill at more than five or six places between London and Holyhead."

The information given in relation to ascending and descending hills, having a local reference, we give only the general results.

A hill of the slope of one in eighteen, (about 3° 10′,) Mr. Farey considers too steep to be ascended by locomotives in their present state, without risk of fracture, unless assisted by horses, the road not being supposed of the best sort. They could ascend a hill of one in thirty, (about 2°,) without assistance.

We return to the printed evidence of Mr. Farey.

"Have you turned your attention to the subject of apportioning the tolls on steam carriages, so that they may bear their due proportion to the tolls on carriages drawn by horses? No, I have not paid much attention thereto; it is a subject which would require more consideration and more data than I have before me. I am convinced that if a steam coach, complete when travelling, weighs no more on an average than a stage coach with its four horses complete weighs on an average, there is no reason for charging any extra toll for steam coaches, but, on the contrary, I believe it will turn out in the sequel that they ought to go for less toll, because they will wear the roads less than the present coaches whenever they are made really efficient; and, in the mean time, until that is accomplished, I think it may be very safely left to the chance of events as to injuring the roads to any extent whatever, by injudicious attempts to work steam coaches of an injurious construction; from the consideration that if any new coach which may be started, does injure the road, it will be very soon given up from its own demerits, probably before it has produced any visible effect on the road. Suppose its wheels were to slip so much as to plough out ruts on the road, it would most probably stick fast, or be broken to pieces in the first journey along the road, and such abortive attempts will not be repeated very frequently. It is idle to talk of one or two steam carriages doing much visible injury to a frequented road in a year or two, even if they run constantly, for suppose that each one wears the road four or five times as much as one carriage of the same weight drawn by horses (including those horses in the weight,) it would only be equivalent to four or five additional coaches passing each day, and that on the road from London to Birmingham, for instance, would be quite imperceptible. I am confident that any steam coach which does a road any greater damage than is equivalent to that done by carriages drawn by horses, will fail of itself in a short time, and prove an unsuccessful project. I should strongly recommend the new system to be left to its own chance of success or failure, as far as the roads and the safety of passengers are concerned; and I think the same reasoning applies against any regulation for the breadth of the wheels for steam carriages, because they will not perform well if their wheels are so narrow as to cut the road materially. I understand that the old system of regulations and penalties, as to over weights on given breadths of wheels for common carriages, has been done away with on the roads in an extensive district round London, and I think it is good policy, from the circumstance that the proportion regulates itself by the interest of the owners of carriages, when the fact is understood that carriage wheels, which are too narrow in proportion to the load on them, and to the hardness and goodness of the road, will always draw more heavily than wheels of a suitable breadth; and that, though the carriers may not find out the proper breadth at once, they will do so in the end. The old acts for forcing the use of very broad wheels by making tolls operate as penalties and premiums, was a most injudicious system of legislation, and did nothing but harm; the carriers soon found out how to evade the intention of the act, by using very broad conical or barrelled wheels, rounding on the edges, which conformed to the words of the law, but which acted on the road like narrow wheels. The broad wheels intended to have been encouraged by the old act of parliament, were expected to act as rollers to make and improve the roads, and were encouraged to carry excessive loads for that object; but if the wheels of the broad wheeled wagons not actually used had been really such as the legislature contemplated, they could have been continued in use on account of the great increase of draught; but the broad wheels actually used, carried such loads, that they crushed the road materials to powder, owing to the conical form of the wheels and the bending of the axletrees; they bore on the road almost wholly at the inner edges of the iron tires, and not across all their breadth, as was intended. The advantage to the carriers in tolls, and in increased loads, induced them to use such broad-wheels, when it would have been against their interest to have done so, if they had paid the same tolls for the weight of goods as other carriers, and their operation on the road was more injurious than that of any other carriages. There is no particular breadth of wheels which can be prescribed as the best to carry given loads over all sorts of roads, for much depends upon the hardness of the road materials, the size to which the pieces are broken, their general form and disposition to consolidate into a hard bed, the resistance the materials offer to wet and frost, and to wearing by the wheels; the breadth of the wheels, and the load upon them, should be adapted to all the combinations of circumstances, and the carrier will soon find, if his wheels are not best adapted to the road, by the draught being greater than it ought to be. As to steam coaches, the wear which will take place on roads, from all that can, by any probability, be expected to be brought into use for some years, will be so small that it cannot be felt for a considerable period, and when it is felt, it will be time to look round and see what is the real effect on the roads of those particular coaches which are in use, and apportion the tolls that they ought to pay."

"Is it your opinion that weight for weight, including the weight of horses on one hand, and of engines, and an average of the water and fuel on the other, the tolls should be the same on steam carriages as on horse-drawn carriages? I think that if it were so it would prove a considerable advantage to the roads, because as I have stated before, I think the roads will be considerably benefitted by the change of impelling by steam instead of by horses. I think it will be a great public benefit when steam coaches come into common use, and hence that it is expedient that a moderate bounty should be offered for the adoption of steam carriages, by giving them all possible advantage they can have without trenching on the interests of individuals; and if they were allowed to run toll free, and duty free, until a certain number were in use, or during a certain time, it would much accelerate their introduction, because it would diminish the loss that must necessarily be incurred by running them before they are perfected in their construction. Small encouragements or discouragements have a considerable effect on new inventions in their infant and imperfect state. The advantage to the public from steam navigation is now generally acknowledged, but when steam-boats were in their infancy, an attempt was made by the watermen on the Thames to suppress them, by contending that, according to their charter, and the usage of the city of London, no persons could be allowed to own a vessel plying for passengers on the Thames, nor to work on board of such a vessel, except they were freemen of the city, and belonging to the watermen's chest. This would have effectually prevented any engine men being employed, and, in addition, the watermen engaged all their members to refuse to navigate them. After a long dispute and delay of the steam-boats, it was decided that one out of a number of owners being free was sufficient, and that the men employed to manage the engines were not subject to the watermen's regulations of freedom of the river; some watermen were induced, by giving them small shares in lieu of wages, to exercise their right of freedom in favour of the real owners, and to navigate the vessel. It was afterwards attempted to get the measurement and calculation for the registered tonnage of the steam vessels made according to the extreme breadth across the projecting boxes which contain paddle wheels, under the pretext that they occupied that width in the river and in harbours, instead of measuring the breadth of the vessel at the surface of the water. If that could have been enforced, it would have nearly doubled all the rates on steam vessels, compared with other vessels; but the subject being brought before parliament, an act was passed to give them the advantage of deducting as much from the length of the vessel as is occupied by engines and machinery in calculating the registered tonnage. This was, in effect, a small bounty upon steam vessels, for they have no claim to such an advantage over sailing vessels; when the weight of masts, sails, and rigging, in the latter, is not deducted in calculating their tonnage. The effect of that measure has been favourable to the advancement of steam navigation, for though it was but a very trifling bounty, and is now of no consequence, it came as a well-timed aid, at the date when that act passed, because almost all steam vessels were then navigated at a loss, they were so imperfect (like steam coaches at the present day,) that their engines were continually getting out of order, whereby they failed to make their passages, and required expensive repairs; their consumption of fuel was great, and the wear of boiler excessive. On the other hand, few passengers would go in them at first, and some terrible accidents which happened in a few vessels, caused them all to be avoided by passengers for a long time. It was only by persisting in keeping them going as well as they could, and thereby gaining experience in their management, that the numerous defects of their construction were remedied. Most of the earliest steamboats had two or three successive editions of engines and machinery before they were rendered so perfect as to become profitable; and, in addition to the expenses of such alterations and improvements in the machinery, they were obliged to make their passages regularly for some time after they were rendered tolerably effective before they acquired sufficient confidence with the public as to their safety and punctuality, to enable them to obtain as many passengers as would pay the expenses of navigating the vessels. For all these reasons any increase of their expenses was severely felt at that losing period; many were abandoned, and the difference in the expenses occasioned by the rates to which vessels are liable, being calculated according to the breadth across the paddle wheels, or according to the act passed for measuring them short by all the space taken up by the engines, would have occasioned others which have been brought to bear to have been given up, before they had attained so much perfection as to enable them to earn their expenses. In the same manner the tolls levied upon steam coaches at present are to be regarded, not as payments out of the profits of a gainful trade, but as an increase of loss upon that which is yet, and which must inevitably continue to be for some time, a losing business. The ultimate success to which I look forward is entirely dependent on the circumstance of the first speculators in steam coaches being enabled to go through a sufficient term of inefficient performance, and consequent loss, to acquire experience in the new business; and that experience will, no doubt, lead to expensive alterations and re-constructions of their machinery. There is so much mechanical talent to be had for money, that I have no doubt of the final accomplishment, if the attempts now making are continued long enough; because I am confident that there is (as was the case in steam-boats) a real efficacy in the principle of action. The general opinion of engineers was not very favourable to steam-boats, when they were first brought forward as a novelty; many doubted if they could ever be made to perform well, particularly at sea; and others, who foresaw the possibility of that, doubted whether they would answer in point of expense of fuel; and wear and tear of engines and boilers. If no assistance or encouragement is given to inventions when they are in the infant state which steam coaches are now in, persons who find that they only lose money when they expected to gain, by being the first to adopt the improvements, are liable to become disheartened, and give up the pursuit too precipitately, whereby their undertaking dies a natural death; and that is sometimes the case when it might have been established by another two or three weeks' continuance of the efforts; and that continuance might be induced by some small relief, like the reduction which was made by parliament in the register tonnage of steam vessels, or the taking off of the tolls from the earliest steam coaches. If by any means they are enabled to go on till the proper plan of machinery and management is found out, they will afterwards keep their ground, because the profit of working by steam in lieu of horses will be very great. The present steam coaches are mere experiments, and the next editions of each plan of them will, I expect, be losing concerns, and will continue so to be for some time. Under those circumstances, every small increase of their expenses is a real retardation to that practical establishment of the invention which will render it useful to the public; such retardation by small causes is operative to a greater extent than can easily be conceived. Steam coaches will very well bear all tolls and taxes to which other coaches are subject, when they are able to carry passengers regularly and profitably; but they want encouragement now, instead of difficulties being thrown in their way. As to the right of tolls on turnpike roads, it should be recollected that turnpike roads are not property, like canals, but trusts, to be exercised for the benefit of the public; and if it is for the interest of the public that steam coaches should be brought into use, and if that bringing into use will be accelerated by suspending the tolls on them at first, the trustees of roads ought not to object to such an arrangement. The real amount of tolls they will forego, will be an exceedingly small per centage on the income of their tolls; for so long as steam coaches are losing concerns, they cannot be very numerous."

"In the course of your examination, have you meant to confine your evidence to steam coaches? Yes, to steam coaches for public conveyance of passengers and parcels, in the manner of stage coaches, and travelling at the rate of ten miles an hour on our best lines of turnpike roads, with occasional assistance of one or two post horses, where necessary, to surmount unusual hills, or very bad pieces of new laid road. If it were thought admissible to begin with travelling at a less speed than that, and to carry goods only in the manner of vans, the thing is nearer to accomplishment, because the accommodation and comfort of passengers would then be out of the question, and also the violence to which quick travelling carriages are subjected, requires a greater strength of all the parts than would be necessary to carry the same weight at a lower speed. In other respects steam power will propel a carriage as cheaply at a quick rate as at a slow rate. That fact is proved on rail-ways, in actual business; and steam coaches will be the same whenever they can be made strong enough to bear quick motion without being overloaded with weight of machinery. That will be one of their great advantages over horse labour, which becomes more and more expensive as the speed is increased. There is every reason to expect, that, in the end, the rate of travelling by steam will be much quicker than the utmost speed of travelling by horses; in short, that safety to travellers will become the limit to speed, as is now the case on rail-ways."

"What is your opinion as to impelling wagons by steam? I have never considered that at all in detail, and am not prepared to give evidence upon the subject. The price of carrying passengers or goods at a quick speed, as is done by stage coaches, or vans, will always be so much higher than the prices of carrying an equal weight at a slow speed, as is done by wagons, that I see no inducement to attempt steam wagons, which I think would present almost all the difficulties of steam vans. According to theory, the cost of carriage by steam will, as I have stated, be proportionate to weight and distance, without regard to speed of motion; for instance, to convey a coach loaded with two tons for a distance of ten miles only, the same fuel will be consumed, and the same wear of machinery will be occasioned, whether that distance is run in one hour or in four hours. The wages of engineers, conductor, and guard, will be only one-fourth with the quick speed, and the first outlay in machinery would be only one-fourth, because four times as many engines must be on the road, with their attendants, at the same time, to do the work at a slow speed, as at a quick speed; but the money earned by the carrier at the slow speed, will be only a small part of what would be earned at the quick speed."

"Taking into consideration the comparative expense of horse carriages and steam carriages, do you suppose that steam carriages will be able to run for half the charges of horse carriages? My own idea is, that steam coaches will, very soon after their first establishment, be run for one-third of the cost of the present stage coaches; but to become a business at all, it must necessarily be a busisiness which will offer strong inducements to persons to embark in it, and to do that, the rate of profit must be very much greater than that which is commonly expected to be realized by the proprietors of stage coaches. Their present trade affords a less profit on the capital and trouble of management probably than any other sort of business which is carried on with spirit in this country. The great reason of that is, the constant loss by destruction of horses, the fluctuations of the price and quality of horse-keep, and the impossibility of reducing stage coach establishments in times when travelling business is flat; because the horses must be kept, and men to attend them, at all events, and the loss of running a coach half employed is not so great as suspending it, and keeping the horses idle on short allowance till better times come round. The profit of stage coaches which load well is very high, particularly in the fine travelling season, and that occasional profit creates an excitement which induces the injudicious to set up more coaches than are wanted for an average of all seasons; and for the reasons above stated, their expenses when once set going, cannot be reduced to meet bad times. The adoption of steam coaches will set the trade free from its great commercial difficulty, because they can be laid up and kept idle without considerable loss, and brought out again when wanted without any new outlay; also, fuel does not fluctuate either in price or quality to any considerable extent, like horse corn. In short, the capital embarked in a steam coach trade will not be so rapidly wasted as at present in horses. Owing to the great number of horses which must be first bought and then kept to do the same work as one steam coach, the first outlay in stock will be very small in steam coaches, compared with horses, the same of stables, hostlers, and harness. The daily expenses of fuel and attendants will be very much less than that of horse keep and attendance; the wear and tear of the coaches, and all that is coachmaker's work, will be only the same as at present, but the wear and tear of engines and machinery, though a very expensive item on each engine, will be nothing to compare with the present repairs, loss, and decay of horses, because the number of engines is so small. Stage coach horses require to be all renewed every three years, notwithstanding a heavy annual expense for what may be called repairs of horses: viz. harness, shoeing, and farriery. Engines with an equally heavy annual expense of repairs to that of horses, will, when perfected, be kept up thereby in such a state as to last for many years without renewal. The metal parts of machinery only wear at particular places, which are capable of being repaired or renewed, so that they become as good as new; but a horse, when worn to disease at any part, feet, eyes, or lungs, becomes incapable of stage coach work forever afterwards."

"Do you apply the principle you have stated respecting the probable wear of the roads by steam power being less than by horses, to heavy wagons? Yes: my proposition that the wear of the roads will always be at the expense of the carrier, applies to all carriages whatever, but more particularly to those impelled by steam than to those drawn by horses, because carriages drawn by horses may be so mismanaged, as to do very great injury to the roads, and yet may make good progress in travelling. For instance, a wagon having very narrow wheels, carrying a heavy overload, having a sufficient team of strong heavy horses, may be drawn along although it breaks the road up to any extent, and that as much by the feet of the horses as by the narrow wheels; but, if it were attempted to impel the same wagon by steam power acting by the adhesion of the wheels to the road, they would slip round, and it would not get along the road. I am confident that carriages to be impelled by steam machinery turning the wheels, cannot be made to answer any good purpose, either for conveyance of travellers, or goods, so long as they materially injure the roads, because if the wheels slip materially on the road, or if they cut sensible ruts in the road, they will not advance the carriage efficiently. On the other hand, horses may be made to draw a carriage which will injure the road. I think that principle must apply to steam wagons as well as to steam coaches."

"The heavier the loads to be drawn, the more important it is to apply steam instead of horses, if the roads will be benefitted by that substitution? I think so, as far as the roads are concerned, but I doubt if steam wagons will offer any comparison of the profit to be derived from steam coaches. To get along the road, steam wagons will require very broad wheels, and there is no danger of doing injury to the road by them, for they will not get along if the wheels are too narrow, but narrow wheeled wagons drawn by horses may do an injury to any extent, for extra horses may be put on, and they will injure the road with their feet, at the same time that they draw a carriage after them which also injures the road. It will be a loss to the carrier to do so, but there is nothing in the nature of the operation to prevent it being done, as there would be in the case of steam wagons."

"Of course, a steam carriage going slower than ten miles an hour will be more expensive to travel, on account of the greater expenditure of fuel? No; the consumption of fuel, according to time, would be as much less as the motion would be slower; so that the consumption of fuel, according to distance, would be the same, whether for a quick speed or for a slow speed; but when profit is considered, every thing is in favour of quick speed; because all goods carried slow must be carried cheap; and quick conveyance will bear the highest price of carriage, on account of the expense of going quick by horses. For instance, a ton of goods may be carried a mile by steam power with a certain consumption of fuel, but it should take no more fuel to carry it a mile, at the rate of two and a half miles an hour, than at ten miles an hour. There is some qualification to be made in that statement according to the state of the roads; it will be true if they are hard and good, but if they are heavy, the expense of fuel will be a little more for the quick speed than for the slower speed; and it is also to be understood, that the engines must be suitably proportioned for attaining quick speeds, because engines, which are only adapted for slow motion, do not work to so great an advantage when they are urged to work quick as when they are worked at or below the speed which the proportions of their parts are adapted to move with; nevertheless, that extra expense of going quick by steam power will be but small, and nothing like the increased cost of travelling quick with horses; for horses have only a limited speed at which they can travel, if they have no load to carry or drag after them, the whole of their muscular strength being then required to advance the weight of their own bodies. The speed with which stage coaches now travel, approaches so near to the speed with which the horse could travel without any load, that their force of draught becomes very small. In all cases, horses lose force of draught in a much greater proportion than they gain speed, and hence the work they do becomes more expensive as they go quicker. The quickest stage coach travelling is now at the rate of eleven miles an hour, and that appears to be very near to the utmost limits which nature has prescribed for animal exertion; for those horses require renewal of the whole stock every two or three years. This is the comparison of steam power and horse labour, during the time that each is actually in operation; but the real difference between the performance of a steam engine and that of a set of horses will be found to be very great, when it is considered, that, by having one spare steam coach for every two or three which are on the road, those coaches can travel continually all the year round, during fourteen or fifteen hours in every twenty-four hours, without any intermission, except stopping for one or two minutes to take in water at every stage of about seven or eight miles; and thus each steam coach can travel 140 or 150 miles a day, whereas a set of four stage coach horses can only work during seven hours and a half out of every twenty-four hours, or each horse can run fifteen miles a day, and that exertion wears them out very soon. A cart horse, travelling at the rate of two miles and a half an hour, can work during eight hours out of every twenty-four hours, or he can travel twenty miles in a day. Suppose that in both cases, of horses going ten miles an hour, or only two miles and a half an hour, the force of traction was the same during the time that they were actually drawing; even on that supposition, there would be the difference between twenty miles a day and fifteen miles a day in favour of slow travelling; but in considering the work performed, the great loss in the force of draught by quick travelling must be taken into account; and it will be found that a cart horse walking at two miles and a half an hour, could draw with a force of traction 100 lbs. on an average, but that a stage coach horse, running at ten miles an hour, cannot exert more than 28 lbs. force of traction at an average. The above proportion of distance travelled, and force of traction exerted in each case being combined into one product, the portion will stand thus: 20 miles a day × 100 lbs. draught = 20,000, to represent the work done by a horse travelling at the rate of two miles and a half an hour, and fifteen miles a day × 28 lbs. draught = 420 to represent the work done by a horse travelling at the rate of ten miles an hour, which is four and three-fourths to one in favour of a slow speed; when with steam power there would be only a very slight difference of performance at the quick or the slow speed."

"Respecting the injury done to the roads by heavy carriages, whether they are drawn by horses or impelled by steam power, you consider that weight for weight (including horses and engines as part of the weight) the one will not do more injury to the road than the other? In my opinion, the steam carriages will do the least injury of the two. The horses, by treading with their feet, excavate and scrape out depressions in the surface of the road; that is particularly the case before the road materials are consolidated into a solid mass; and the evil of depressions or holes in the road is not the mere injury done by the feet of the horses to those particular parts of the road in which the depressions are made, but the wheels of other carriages which pass over such depressions, drop heavily with force into them, so as to make the depressions continually deeper and larger, and to loosen the surrounding stones. In this manner the horses, after injuring the road themselves, prepare the way for further injury to the road by the wheels of carriages. To have the full benefit of the rolling action of the wheels in consolidating the road materials, the latter must be laid smooth and level before the wheels come upon them; but if the materials are previously thrown up into little hills and holes, the wheels will do mischief instead of good."

"Suppose the engine and machinery in a steam carriage to weigh two tons, and to be able to advance an additional load, equal to their own weight, along a good road, at an average speed of ten miles an hour, do you think that any additional toll should be imposed upon steam carriages beyond that paid by four horse stage coaches, or vans; assuming the four horses to weigh two tons, and to draw a load of two tons, at the rate of ten miles an hour? In such a case, I can see no reason whatever for any increase of toll; but the diminished wear of the roads, which I anticipate from the use of steam in lieu of horses, will be a reason for a reduction of tolls whenever such a diminution of wear is realized."

"Would horses drawing eighty cwt. upon a road, with a slow walking pace, in your opinion, do more injury to the road than an engine doing the same work? I have had no experience of drawing heavy weights by steam to enable me to form an opinion respecting the effect that the broad wheels, which must then be used, would have on the road, and what advancing power they would have before they began to slip on the road, without advancing the carriage forwards; nor what would be the weight of engines which could advance eighty cwt. at a slow speed. I feel some doubt of the practicability of making steam engines advance so many times their own weight, as I expect this would be, with effect, and I feel confident that, in the present state of the art, there would be no profit in doing it; but if it were accomplished, I believe that the broad wheels of the steam wagon would do no injury to the road, whereas, in heavy wagons, drawn slowly by horses, the horses do much more injury by digging and scraping with their feet than is done by the horse in coaches and vans travelling quickly; because the wagon horses having a heavy pull to make must choose places in the road where they can place their feet in depressions, in order to get hold; hence, on a good smooth road they slip and scrape up the surface."

[TO BE CONTINUED.]

Tract on Comets, and particularly on the Comet that is to intersect the earth's path in October, 1832. *By M. Arago. Translated from the French, by John Farrar, Boston*, 1832.

We avail ourselves of the privilege afforded by our title page, in which our devotion to general science is expressed, to give a notice with extracts from an essay on *comets* lately set forth by the French philosopher Arago. This tract comes to us in an English dress through the translation of Professor Farrar, of Cambridge, Massachusetts: it was, in the original, an essay in the almanack for 1832, published by the French Board of Longitude.* It would be thankless in us, after having the labour of translation done for us, to find fault with the manner of its execution; besides, we know experimentally the difficulty of avoiding gallicisms in a translation from the French; we may, notwithstanding, venture the remark that the French astronomer would have appeared better, before the American public, if a few of his national peculiarities had been softened down to suit the more frigid temperament of his new readers.

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* Mémorial du Bureau des Longitudes, 1832.

The comet which was the "exciting cause" of this essay by M. Arago, is one which unassisted eyes are promised a sight of in the months of October and November of this year; not, as a widely spread two-penny tract would have us believe, growing in size until it rivals the full moon in shining, and with a tail overspreading half the heavens, but with even more modest pretensions to notice than when it last visited us in 1826. The humble little publication to which I have just referred, after exciting our consternation by the description of a mighty monster, gravely tells that it cannot hurt, and that as harmless as the bright moon itself it will decrease as it had increased, and disappear from our astonished sight.

The veritable account which M. Arago gives of this comet is as follows.

Comet of Six Years and Three Quarters.

"We have now come in our account of comets to another periodical one, which is to reappear, like that just described, in 1832, and whose near approach, we are told, will be attended with fatal consequences to the earth and its inhabitants.

"This comet was discovered at Johannisburg on the 27th of February, 1826, by M. Biela, and ten days afterwards at Marseilles, by M. Gambart. The latter calculated the parabolic elements without delay, by means of his own observations, and immediately perceived, on consulting the table of the elements of comets, that this was not its first appearance, but that it had been already observed in 1805 and in 1772.

"The comet of 1826 is therefore periodical.

"It was accordingly necessary to change the parabolic elements into elliptical elements, in order to discover the length of the comet's orbit left undetermined by the former. Messrs. Clausen and Gambart undertook this calculation, and each found, at nearly the same time, that the new comet made a revolution round the sun in about seven years.

"This curious result was adopted without dispute; for, in 1826, astronomers were cured of their old notion that the revolution of a comet must *necessarily* be very long; while, from the example of the comet of 1770, it was deemed imprudent to venture to determine the time of the future reappearance of a new comet, before all the derangements and perturbations to which it was liable in its whole course, had been thoroughly studied. My colleague, M. Damoiseau, undertook this long and minute calculation, the result of which is as follows.

"The comet of six years and three quarters will cross the plane of the ecliptic, that is, the plane in which the earth moves on the 29th of October, 1832, before midnight.

"The earth, during its annual course round the sun, never leaves the plane of the ecliptic; therefore it is only somewhere in this plane that a comet could strike it; of course, if we had any thing to fear from the comet of 1832, the danger would be on the 29th of October, before midnight.

"Now let us inquire whether the point, at which the comet will cross the plane of the ecliptic, is near the path that the earth describes; for, in order that there may be a meeting between the two bodies, this is as necessary a condition as the other.

"Upon this point it is proved, by calculation, that the passage of the comet through the plane of the ecliptic *will be a little within our orbit, and at a distance from it equal to two and a third of the earth's diameters, or* 18,500 *miles.* It is possible that this distance, already so small, may disappear entirely, if we suppose certain small variations in the elements, given by Damoiseau, which it is difficult to answer for.

"Let us, however, take two diameters and a third, as the real distance; we must remember that this has reference to the centre of the comet, and we must ascertain whether its size is large enough for any part of it to extend to the earth's orbit.

"When this body appeared in 1805, the observations made by the celebrated M. Olbers, of Bremen, gave for the semidiameter of the comet two diameters and two thirds of the earth. From this number, compared with the preceding, it plainly results, that on *the* 29*th of next October, a portion of the earth's orbit will be comprehended within the nebulous atmosphere of the comet.*

"There remains now but one more question to answer, it is this: At the time when the comet will be so very near our orbit that the nebulous or hairy *atmosphere* will cover some part of it, *where will the earth itself be?*

"I have already said that the passage of the comet very near to a certain part of the earth's orbit, will take place on the 29th of October, before midnight; well, the earth will not arrive *at that same point*, until the 30th of November in the morning, that is, *more than a month afterwards!* Now we have only to call to mind that the average rate at which the earth moves in its orbit is 1620 thousand miles per day, and a very simple calculation will show, that

"*The comet of six years and three quarters will, during its appearance in* 1832, *be always more than forty-eight millions of miles from the earth.*

"In order to ascertain the least distance of the comet from the earth in its future returns, the same calculations must be made. If in this year, 1832, instead of passing the plane of the ecliptic on the night of the 29th of October, it reached that point on the morning of the 30th of November, it would certainly mingle its atmosphere with ours, and perhaps it would strike us. But I hasten to assure the public that a mistake of a month, in determining the time when a comet reaches its node, is impossible. I have confined myself in this account to what relates to the body of the comet, because no trace of any tail has ever been seen to accompany it in its former visits.

"The reader is now in possession of all that can interest him with respect to the course of the comet of October, 1832. The foregoing facts do not differ from those which M. Olbers published in a note, the meaning of which has been so strangely mistaken by the public and by several journalists. Shall I be more successful in my endeavours to explain myself? I hope so; but I cannot be very confident so long as there are persons who, believing that the earth will not come in contact with the comet or receive any direct injury from it, yet think that the comet cannot cross the earth's orbit without altering its form, as if this orbit were a material substance; as if the parabolic line described by a bomb through the air, when discharged from a mortar, could be affected in its course by other bombs having formerly been projected through the same space."

We find then that this comet will never be nearer to us than forty-eight millions of miles; within only twice this distance we perform our round unharmed about the great central fire, in obedience to the attraction of which the comet, as well as ourselves, moves.

As the calculation of our security from ill effects by collision with the comet rests upon the time at which it will intersect the earth's orbit, M. Arago proceeds, by way of rendering assurance doubly sure, to examine the causes which might be said to cast a doubt upon the conclusions which he has stated. The first of these alleged sources of error is the effect of a resisting medium in the planetary spaces, which, by retarding the comet in its course might be supposed to bring it *later* to the earth's orbit than the time calculated. As we see the velocities of bodies diminished by resistance, this idea seems at first plausible, and we abandon it only after finding the imperfect nature of the reasoning by which we drew our conclusions. The effect of a resisting medium would be to decrease the force by which the comet tended from the sun; it would therefore be drawn nearer the sun, and, hence, be made to describe a smaller orbit, and with an increased velocity. The effect then of such a resistance would be to cause the comet to arrive sooner, instead of later, at the earth's orbit, and in this case to increase the distance between it and the earth. Comets become interesting in a scientific point of view as enabling us to detect the existence of this very attenuated medium which fills space, and the experiments of modern astronomy are employed in studying the question. Already Encke's comet has shown in its frequent returns (every three and one-tenth years) a small acceleration of about two days, which Encke considers attributable to this cause.

It is not our purpose to follow M. Arago in the various questions which he examines; our readers who feel disposed to look over these will find wherewith to amuse and to interest, plainly set down; they will see that astronomers as well as poets give the rein to imagination, and will find, with them, how limited a view our intellect can take of the vast phenomena of nature.

It may not be amiss to state that M. Arago examines the following among other questions, and proves clearly by facts that a negative answer must be returned to each and every one.

Do comets affect the seasons? Was the fog of 1831 produced by the influence of a comet? Has Siberia changed its climate from a similar influence? Is it necessary to resort to the influence of a comet to explain the severe climate of North America?

We will not quit the subject without a word upon the (so called) lost comet of 1770. It affords a fine instance of the grasp of human intellect, and is well calculated to inspire us with confidence in the results of the calculations of astronomers. It shows us, also, how inconsiderable must be the masses of these bodies which once inspired such terror in our race.

Between the months of June and October, 1770, a comet was visible, the orbit of which was found, by calculation, to be an ellipse, in which the comet made an entire revolution in five and a half years. The facts that this comet, though of so short a period, had not been recorded as visible previous to this time, and that it was not visible in 1776 (five and a half years after its first appearance,) threw a doubt upon the calculations of Lexell, and induced the Institute of France to propose a prize for a complete investigation of its orbit, to include the perturbations to which it might have been liable. Burckhardt, by the aid of certain analytical formulæ of La Place, was enabled to solve the mystery which hung about this comet. The orbit found by Lexell was confirmed as the true one, and in tracing back the course of the comet in this orbit, prior to its appearance in 1770, Burckhardt ascertained that in 1767 it had been within the sphere of attraction of the planet Jupiter, the attraction of which planet, at the nearest approach of the comet to it had been three times that of the sun. By means of the analytical processes to which we have before alluded, Burckhardt was enabled to determine that had the comet been, prior to 1767, moving in a large orbit, of which the least distance from the sun was greater than that of Jupiter from the same body, and in which its period was fifty years, the attractive force of the planet would have been sufficient to draw it into its new orbit, the least distance of which from the sun was less than the radius of the earth's orbit. The comet was not seen prior to 1770 on account of its great distance from the earth, which distance, when at the smallest, exceeded that of the planet Jupiter. Next by following the comet in its orbit, in 1776, when it should have reappeared, Burckhardt found that the sun was interposed between the earth and the comet, so as to render the latter invisible. The non-appearance in 1776 was thus accounted for. But why has the return of this comet not been noticed? An answer was also given to this question. The time of revolution of the planet Jupiter in its orbit is about twelve years; hence in 1779 the comet came a second time within the influence of the attraction of the planet, but in different relative situations from those which had occurred twelve years before; the attraction of the planet was exerted sensibly for nearly five months, and the orbit was again changed. The least distance of this new orbit from the sun is not nearer than the planet Ceres, and the time of revolution about twenty years. Unless this comet should again be subjected to perturbations bringing it nearer to our part of the planetary system, it cannot again be visible from the earth.

The inconsiderable mass of the body just spoken of, is proved by the fact that while the attraction of the planet Jupiter caused such entire changes in the orbit of the comet, the latter did not perceptibly affect the motions of the planet, and not even those of its satellites. We are prepared from these observations to expect the result which the calculations of La Place gave, in relation to the effect of this comet on the earth's motion, namely, that passing as near to the earth as fifteen hundredths of the earth's distance from the sun, and having its own period of revolution affected two days by the earth's attraction, the reciprocal effect upon the earth's motion was insensible.

B.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MAY, 1832.

With Remarks and Exemplifications, by the Editor.

1. For a *Mill for Grinding Grain, Paints, &c.;* William G. Johnson, city of Philadelphia, May 3.

This mill is to be constructed in the usual manner, excepting the apparatus for pressing the stones together, which apparatus, we are informed by the patentee, consists of a horizontal lever, a regulating screw, compound levers and weights, and a moveable and fixed collar.

In form and action this apparatus bears a near resemblance to the governor of a wind mill, or steam engine, but it is not made to revolve, being acted upon in another way. When the stone is raised, it presses against a lever, connected with the governor, and this throws out the two balls, or weights, causing them to act with greater force, upon the stone, and thus prevent its further rise. The effective pressure upon the stone is in this way increased, or diminished, as it rises from, or approaches towards, the bed stone. It is this particular arrangement which forms the subject of the claim.

2. For *Applying Wind to the Propelling of Boats, Vessels, or Land Vehicles, Mills, Lathes, and other Machinery;* Benjamin Dugdale, city of Trenton, New Jersey, May 3.

The specification of the machinery employed does not make its structure clear, says nothing of its mode of operation, and lays no claim to any part of the apparatus. The drawing, in our judgment, throws but little light upon the subject, as it has not enabled us to perceive how the patentee intends that his machinery shall operate in propelling. Its general appearance is that of the horizontal wind mill, but we see no contrivance for feathering the sails. There is a vertical shaft, from the upper end of which project ten, or more, horizontal arms, and a corresponding number at a proper distance below. Iron rods extend from the extremities of the lower to the extremities of the upper arms, thus forming the skeleton of a lantern. Sails which may be lowered or raised by means of pulleys, and which have rings on their edges that slide on the iron rod, form, when raised, pannels all around the lantern, and present to us a regular polygon. We leave to others to divine how boats, vessels, land vehicles, mills, lathes, and other machinery, are to be propelled by this contrivance. Could we discover in what way the wind is to operate upon the sails, we could tell how to apply their revolution so as to effect some of the ends proposed; even then, however, we should be obliged to leave the boats and vessels out of the question, unless we were permitted to locate our wind mill on the shore, and to extend a tow line from it to the vessels on the water.

3. For an improvement in *Saddles*; George Pritchard, Clarksbury, Harrison county, Virginia, May 3.

Steel springs are to be formed by winding pieces of wire, of one-eighth of an inch in diameter and five feet long, round quadrangular bars of iron, five-eighths of an inch wide and three-eighths thick. Two of these springs are to be used with each saddle. They are to be fastened by one end under the cap plate, and on the head of the tree, and by the other to webbing attached to the cantle in the usual manner, thus giving a high degree of elasticity to the seat, which cannot exist when the webbing extends to the head of the tree.

The patentee alludes to other modes, previously patented, of fixing elastic springs to saddles, but considers that just described as more durable, and as preferable on several accounts.

4. For *Machinery for Liming and Handling Skins in Tanning;* Caleb Hank, Monroe county, Virginia, May 3.

The machine for liming consists, in part, of a frame made in the manner of a bedstead, having cords stretched across as in the corded kind. Upon this net work the skins in the liming vat lie, and when they are to be aired they are raised by means of a windlass and pulley attached to a framing over the vat. Ropes descend and are hooked to staples in each corner of the liming frame for this purpose.

The handling apparatus is also supported on a frame over the vat. The skins are all attached to each other by ropes at their ends, and a part of the handling apparatus consists of a roller, turned by a crank, which roller extends across the vat, and is of sufficient length to receive the skins. Ropes from the upper skin are attached to the roller, and on turning this the continued sheet of skins is rolled upon it, the ooze falling back into the vat. There are some contrivances about this apparatus which we have not noticed, but what we have said exhibits its principal features.

5. For a *Self-regulating Horizontal Wind Mill;* Jeremiah Coleman, Vincennes, Knox county, Indiana, May 4.

We just now dismissed one horizontal wind mill because its physiognomy was not sufficiently expressive, or we were not sufficiently skilled in the science to enable us to judge of its disposition; and we are again called to encounter a wind mill which will also prove too much for us, or too little for the patentee. We, however, can give a pretty clear idea of its construction, and know that we have readers who will be thereby enabled to trace its operation, whatever it may be.

There is the usual vertical shaft of the horizontal wind mill, from the upper end of which four arms project in order to support the upper ends of the sails, or wings, and below them four others to sustain their lower ends. The sails, or wings, are made like doors, and, like them, turn, or are hinged upon one edge. A pivot passes from each of these wings into one of the upper, and another into one of the lower arms, and upon these they swing freely without any check or stop. The upper arms, however, are made several inches longer than the lower ones, so that the wings are not hung vertically, but droop, or swag, and there is a contrivance for increasing this drooping when desired; the lower end of the wing being hung on a sliding piece. This part of the contrivance the inventor calls "GRAVITY UPON WIND."

The running gear is to be the same as in any other horizontal wind mill.

The patentee says that "the above described mill is safe with almost any sized wings, as each wing, during a storm, stands with its thin edge to the wind."

The foregoing are all the data, and now let the machinists solve the problem of the action of this machine, and ascertain its comparative value.

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6. For an improvement in the *Grist Mill;* Oliver N. May, Hancock, Delaware county, New York, May 5.

This is another portable grist mill, differing from those which have preceded it in some points of arrangement which are claimed as new. The spindle is kept from rising in a manner like that of some which we have described as having on the lower end a projecting button or fillet with a collar or strap above it; the one now before us is more complex than those alluded to, but the end is attained in a similar way. Instead of weighting the runner directly, we are told that weight may be added to it by "casting the spindle large," and the doing this forms one of the claims. The principal novelty in this mill consists in what is called "a vibrating bolt." This is a frame which may be eighteen inches wide, five high, and of any convenient length; the bottom and sides of it are to be covered with bolting cloth, and the top with any kind of light cloth. This bolter receives the flour from the spout, is placed in an inclined position, and has a vibratory motion given to it from the action of the driving machinery of the mill.

7. For an *Artificial Sedlitz, or Rochelle Water;* Joseph Boston, city of New York, May 5.

This improved mineral water, or *aerated saline aperient*, the patentee calls "imitation Sedlitz or Rochelle water." To prepare it, twenty pounds of carbonate of soda are dissolved in twenty gallons of boiling water, and to this solution is added, in small repeated doses, to avoid too powerful an effervescence, an equal weight of bitartrate of potass (cream of tartar.) After this liquor has cooled it is to be put into a soda water fountain, and impregnated with carbonic acid. This, when taken with any of the usual sirops, becomes an agreeable and active aperient.

Seventeen pounds of common Rochelle salts, and three of the soda dissolved in ten gallons of water, will, it is observed, produce a liquid essentially similar; but when thus made it is more expensive than the first process.

The claim is to the discovery that the foregoing mixtures impregnated with carbonic acid, form a grateful and useful aperient.

To discover, has been defined to be the finding of that which was before unknown; thus viewed, the foregoing fact could not have been discovered by the patentee, as it was before well known. The only thing which could be legitimately claimed in the foregoing process, would be the impregnating of the aperient solution with carbonic acid by the same means which are employed for impregnating the so called soda water. The sedlitz powders may be made by mixing together one drachm of Rochelle salt, and fifteen grains of carbonate of soda, both in powder; and having in another paper twenty grains of tartaric acid. When these are dissolved in water contained in separate tumblers, you obtain something very much like the foregoing mixture impregnated with carbonic acid, and thousands of persons have *discovered* that it is a grateful and useful aperient.

Would not the economy of the process prescribed by the patentee be promoted by collecting the carbonic acid disengaged in making the mixture, and afterwards impregnating the fluid with it. This could certainly be effected by an addition to the apparatus, which might be made at a very small expense.

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8. For an improvement in musical instruments, denominated the *Seraphine, or Harmonicon Organ;* Lewis Zwahlen, city of New York, May 5.

This patent is taken for adding to organ pipes the vibrating springs from which the tones in the common seraphine are derived. A plate of brass, or other metal, is to be attached laterally to one extremity of the pipe, which is then to be fixed in the wind chest in the ordinary way. More than the usual degree of compass, volume, and softness, we are informed, can be thus attained. The patentee observes that the principle resembles that of the reed in the clarionet. Although we have seen this vibrating spring applied in wind instruments, played upon by means of keys, we are not aware that it has been used on organ pipes, and cannot doubt that it may add to the instrument a very good and pleasing stop.

9. For a *Plough;* Joseph Dudley, Fleming county, Kentucky, May 8.

The share and mould board of this plough are in one piece; the instrument is to be made of wrought iron, and put together with nuts, screws, &c. as directed, and when this is done it is then a patent plough.

10. For a *Cooking Stove and Fire-Place;* Edward Potter, Providence, Rhode Island, May 8.

A cooking stove, having a grate for burning coal, a blower, a hole in the plate above the fire, and some of the other ordinary appendages of such affairs, is described, and the patentee then says that "I claim as my invention the before described cooking stove and fire place." We think that the invention must in this instance be microscopic, as we are unable to discover it with spectacles No. 14.

11. For a *Board Shearing Machine;* Simon Willard, Cincinnati, Ohio, May 9.

This machine is intended for cutting laths out of boards, and also for cutting strips and splits for a variety of purposes. Narrow flooring boards, sixteen feet in length, are mentioned as intended to be cut by it.

An iron shaft of the required length is to be extended across a strong frame; for laths, this shaft need not, altogether, exceed six feet in length. On its ends there are to be fly wheels, and on its middle a whirl for driving it. Two cranks work a vibrating cutter, or long knife, up and down between cheeks by which it is steadied. The board, or other article to be cut, is to be fed beneath the knife, where it is supported on a fixed beam.

The claim is to "the combination of the machinery and shears, with the vibrating cutter, to the new and useful purpose of cutting boards, plank, or slabs, lengthwise, into plasterer's laths, narrow flooring, and weaving strips, or splints." The patentee adds that he claims only what he has invented that is new and useful. It is certainly right for an inventor to claim no more than what is new and useful, but it is for him to tell what he considers to be so; although such a declaration would not be a salvo in case of claiming too much, or include any thing described, that is not claimed.

12. For a *Soda Fountain;* Andrew Kirkpatrick and James Fraley, Urbanna, Champaign county, Ohio, May 9.

This new edition of the (so called) soda fountain is, like the former ones, to have two reservoirs, one to contain a solution of carbonate of soda, the other an acid solution, and a double cock for uniting the two in drawing. There are to be smaller reservoirs for containing sirops, with cocks to draw them off; cavities are also provided to contain ice, and a casing around the whole for receiving powdered charcoal, to preserve the temperature.

If the first patent of this kind was good for any thing, it has been violated by all those since taken, as its principal feature, the double cock, distinguishes the whole of them. This, we think, is the seventh patent, within a short period, for what is essentially the same thing.

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13. For a *Thrashing Machine;* Samuel Kable, Beaver creek, Green county, Ohio, May 10.

This thrashing machine is to be made with the ordinary cylinder and concave, and to be fed in the usual way, but the straw and grain are to be delivered from it on to a riddle, or screen, somewhat inclined, and kept vibrating by motion communicated to it from other parts of the machine. The patent is taken for this addition, which is, of course, intended to separate the grain from the straw. There are several thrashing machines which have appended to them an apparatus for separating the straw and grain by means of a riddle, and some of them are also furnished with fans for cleaning the grain: the present patent is, of course, confined to the particular arrangement adopted by the patentee.

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14. For a *Gas Lamp;* Solomon Andrews, Perth Amboy, Middlesex county, New Jersey, May 10.

(The specification will be shortly published.)

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15. For a machine for *Hulling, Cleaning, and Polishing Rice;* Joseph Beach, and Sylvester Starr, Middletown, Middlesex county, Connecticut, May 10.

In a tub, which may be about two feet in diameter, and four feet in height, nine polygonal rollers of wood are made to revolve vertically, one in the centre, and eight around this one. The centre roller may be made octagonal, and ten inches in diameter; the eight which surround it may be five inches and three-fourths in diameter, with the same, or a greater, or less, number of sides than the centre one. These rollers have gudgeons which work below in the bottom of the tub, and above in a cast iron frame fixed to the top of it. A cog wheel upon the centre roller meshes into smaller wheels on the small rollers, and when the centre roller is made to revolve it gives motion to the whole.

The rice is fed into the tub, and is to be hulled and polished by its friction against the rollers, and among its own grains. There is a gate at the bottom to allow the hulled rice to escape. The claim is to the above described combination of the various parts of the machine, so as to produce the intended effect of hulling and polishing the rice.

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16. For a *Machine for Shelling Corn;* William Gee, Templeton, Prince George county, Virginia, May 10.

A wooden wheel is made to revolve vertically, like a grindstone, but its shaft has on it a pinion upon which a toothed wheel acts in order to accelerate its motion. One side of the wheel is set with wrought iron teeth, and the ears of corn are borne against these by a spring board. The plank to which the working parts are affixed, forms an inclined plane down which the cobs descend as the corn is shelled.

The claims put in are to the manner of making the frame, and to the setting of wrought iron teeth into the face of the wooden wheel. This is what some persons might be inclined to call a "wooden contrivance," as machines acting upon the same principle precisely, have been long since made of cast iron, and if the patentee will do as we once did, and send to the Richmond foundry, in his own state, he may purchase a machine very much like his own, but better, because it is made of cast iron.

17. For a machine for *Making Cooper's Rivets* from iron, copper, or other metal; George W. Sowle, New Bedford, Bristol county, Massachusetts, May 11.

The heated metal which is to be made into rivets is passed between two iron rollers, grooved so as to reduce it to the size of the shank of the rivets, and the metal is received by an apparatus which cuts off and heads it. From the nature of the machinery its description would require drawings to make it understood. The claim is to every part of the machine with the exception of the grooved rollers. The description, as given, is obscure, and the drawings themselves are not well executed.

18. For *Paper for covering Buildings;* Frederick A. Taft, Dedham, Norfolk county, Massachusetts, May 11.

Paper is to be made by taking finely ground coal and sulphur, and mixing it intimately with the pulp, after which the sheets are to be formed in the usual way. After the paper has been dried it is to be passed between heated rollers, which will melt the sulphur, and render the paper impervious to water; other materials are to be sometimes employed for the same purpose, and the paper, instead of being rolled, may be pressed between heated plates, or put into an oven.

The proportionate quantities of the materials employed, may be one part, in weight, of fibrous stock, two and a half of brimstone, and two of coal. Salt and lime are sometimes added to render the whole less combustible.

19. For a *Machine for Crimping Boots;* Silas Witherby, Essex, Chittenden county, Vermont, May 12.

A screw is made to force a follower down between the cheeks of a press: upon the follower are two pieces of plank which are forced down upon the crimp. The claim is to "the application of the screw;" and the whole description does not occupy double the space of our notice of it.

20. For a "*Safety Carriage;*" Robert Beale, city of Washington, District of Columbia, May 12.

(See specification.)

21. For an improvement in *Napping Hats*; Joseph Dort, jr., William Wells, and Daniel Olmstead, Buffalo, Erie county, New York, May 12.

There is a tub of about three feet six inches in diameter, and sixteen inches in height; the bottom of this is to be covered with suitable cloth, and it is furnished with a cover fitting it steam tight. A vertical shaft rises in the centre of this tub and passes through the cover. This shaft may be made to revolve by means of a crank and bevelled wheels. From the shaft proceed arms which carry four conical rollers, in the form of hat bodies, that revolve on the bottom of the tub. The bodies to be napped, having the napping previously stuck on, are stretched over these cones, and over them suitable covers are then strained. When they are fixed in their places, the tub is covered, and steam admitted into it through tubes, the revolution of the cones being kept up during the scalding. More than one body may be placed upon a cone at the same time.

There is no claim made; the whole apparatus, it is presumed, being considered as new in its application.

22. For a *Cooking Stove;* Horace Bartlett, Bridgeport, Fairfield county, Connecticut, May 12.

We apprehend, from the construction of this stove, that wood is to be the fuel burnt in it, as it is not furnished with any thing in the nature of a grate, but has a fire-place like that of the common kitchen stove. Above this fire-place is an oven furnished with folding doors, and having ledges upon which to rest tin plates for the baking of bread, &c. This, it appears, is an essential feature in the invention, as the patentee says, "I claim as new the construction of the oven so as to bake eight loaves of bread at one time, placing them in two or three layers deep. To accomplish this, and claim as new, I use a sheet of tin, which, being a non-conductor of heat, and raised from the bottom of the oven, prevent the bottom loaves from burning," &c.

One part of this discovery is certainly new; namely, that tin is a non-conductor of heat; but of the remainder we cannot say so much; the practice of baking loaves and other articles on tin, or sheet iron, is rather antiquated, and the placing them in tiers is not a thing of yesterday. How, and where, holes are left for pots, kettles, and frying pans, we shall not at present attempt to tell, as these parts resemble those for the same purpose in other stoves. Among the claims, however, there is one for "cramping the blaze into small tubes, by which the heat is conveyed off with much greater strength." The smoke escapes through semicircular openings on each side of the oven; and these flues are the small tubes into which the flame is "cramped." The sides of the oven form the flat sides of these flues, and are heated by the flame passing through them.

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23. For a *Machine for Forming Hat Bodies;* Seth Graham, Fayette, Kennebeck county, Maine, May 15.

About three years ago, the patents obtained for forming hat bodies were very numerous; and since that time the processes of napping, stiffening, dying, and washing, have been the subject of various application. The forming machinery, for which the patent before us has been granted, does not differ, in the general principle of its action, from several others. The wool is to be delivered from a carding machine in a continued fleece, and received upon two conical formers revolving against a double conical roller, the fleece, or sheet, being cut along the middle as it winds upon the bases of the conical former.

To give the required crossing direction to the fibres of the wool, the apparatus carrying the rollers, receives a vibratory motion in a way differing from that in which the same end has been attained in other machines. To describe the mode of doing this would require more space than we can conveniently devote to it. The specification ends with the words, "the machine above described I claim as the first and sole inventor." As most of the parts are used in the same way, and for the same purpose, as in other machines, this claim appears to be rather too broad.

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24. For a *Machine for mixing Clay and Mortar* for making bricks, and other purposes; David Phillips, Natchez, Adams county, Mississippi, and John Drummond, Whitestown, Oneida county, New York, May 15.

A wheel is made to revolve in a circular trough, in the ordinary way, and may be four or five feet in diameter, and about one foot thick. Its periphery is covered with plates of iron cast in segments and fastened around it. These segments form circular cutters, or knives, all round the wheel, the blades being about eight inches wide, and having a space of an inch and a half between them. To prevent the clogging of these spaces a comb-like cleaner, supported on a piece of timber attached to the shaft, scrapes between them, while water from a reservoir, also fixed on the shaft, drips upon the clay. The claim is to the before described machine, and particularly to the mixing wheel with blades, and the manner of cleaning them.

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25. For *Coating Lead Pipes with Tin;* Thomas Ewbank, city of New York, May 16.

(See specification.)

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26. For *Preparing the Fillers for Cigars* by a machine called the Filler Breaker; Joseph Maffet, Lancaster, Lancaster county, Pennsylvania, May 16.

This machinery is too complex to be accurately described without a drawing; but the object of it is to roll tobacco for the filling of cigars. For this purpose there is an endless revolving apron, made of leather, or other suitable material, upon which the tobacco to be rolled is spread. This apron passes, by its revolution, under a piece of sheet iron, called the guide, and in doing so the tobacco is rolled, and when there is enough to form a filler, it is broken off by hand, and the operation continued. The claim is to "the before described machine."

We think that this instrument might be simplified, and considerably altered in its combinations. Would it then be "the before described machine."

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27. For an improvement in *Andirons;* William Wilson, Greenfield, Franklin county, Massachusetts, May 16.

In this andiron, the front, or upright part, and the bar and back foot part, are made separate. They are to be put together by means of a wedge-formed dovetail on the front end of the bar, which falls into a corresponding recess formed by projecting cheeks on the back of the upright part.

The advantages of this mode of forming are said to be facility of packing; more easy manufacturing; increased strength, and economy in use, especially when made of cast iron, as one part can be renewed when the other is broken, or burnt out.

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28. For an improvement in the *Paddle Wheel* for steam boats, &c.; John Sheffield and Jonas Ingraham, Buffalo, Erie county, New York, May 17.

We see not the slightest variation in principle, and very little in arrangement, between this paddle wheel and such as have been repeatedly proposed, patented, and essayed, both here and in Europe. The object is to preserve the paddles in a vertical position, and the means of effecting this is the employment of a wheel eccentric to the shaft of the paddle wheel, pins, or cranks, from which act upon the buckets, that are connected also to the rim of the main wheel.

The specification describes the whole very clearly, without, however, taking the slightest notice of the fact that similar wheels have been heretofore made, or furnishing any thing in the form of a claim. A person ignorant upon the subject, and reading this specification, would at once conclude that the whole thing was a new contribution from the arcanum of mechanical science. Such wheels, however, have had fair and long continued trials, but have not been found in any respect superior to the common paddle wheel, whilst they are much more expensive, increase the friction greatly, and, from their complexity, are very liable to derangement.

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29. For an improvement in *Fire Arms;* Joseph W. Plummer, and John Clark, Wayne, Jefferson county, Ohio, May 17.

There is to be a magazine in the breech of the gun, which is to contain powder; and, when the gun is to be loaded, a portion of this powder is to be conveyed, by an apparatus contrived for the purpose, into the barrel. There is an opening in the under side of the barrel, just above the charge, which is closed by a screw, with a crank handle adapted to it. The trigger guard is made to slide back, and to carry with it what is called the charger, which is an iron chamber fitting on the under side of the barrel; when this is drawn back, it receives powder from the breech, and when pushed forward carries it under the hole in the barrel, which has to be turned over to allow the powder to fall in. The ball is afterwards to be inserted, and the screw turned into its place.

There is also a funnel shaped magazine for priming powder, it being made self-priming by the action of the cock.

These parts constitute the *improvements*, which term, however, we think a misnomer. We had supposed that magazines for priming powder were exploded by workmen in consequence of their liability to explode themselves after a gun has been sometime in use. The percussion powder used in such chambers corrodes the gun, whilst the fulminating mercury employed in the percussion caps is free from that objection. Should the charged mine, in the breech of this gun, be accidentally sprung, it would make sad havoc. The loading near the breech at a hole closed by a screw is an old contrivance, and the form in which it is here presented, although it may be new, does not appear to be an improved one. These are a few of the objections to the said contrivance which present themselves to us, the remainder we will not offer, being unwilling to lengthen the catalogue, and shall be most happy to withdraw these, when we see good cause for so doing.

The claim is to the "method of loading, priming, and firing guns, rifles, pistols, and all kinds of fire arms, by means of the magazine, sliding charger, and percussion tube."

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30. For an improvement in *Making Rifles;* Joseph W. Plummer, and John Clark, Wayne, Jefferson county, Ohio, May 17.

This patent is taken for a tool for rifling barrels, and we regret to say that we do not think more favourably of the method of fluting, than we do of the construction of fire arms, patented by the same gentlemen.

Three or more pins, or cutters, are to be made of cast steel, with projecting threads on them having the twist intended to be given to the rifle. These pins are to follow each other successively, as they are to be driven through the smooth bored barrel by a hammer and punch.

We should greatly prefer the rifling machines usually employed, and are much mistaken if the judgment of workmen in general will not coincide with ours. These pins will undoubtedly operate, but not more rapidly than the tools already known, and should one of the cutting threads chip in driving forward, others would be likely to share a similar fate in driving it back.

The claim is to the rifling of guns by means of such pins.

31. For an improvement in the *Striking Clock;* James Bogardus, city of New York, May 18.

This improvement in the striking clock consists, in part, in the winding up of the two barrels at the same time; for this purpose they may both be placed on the same arbor, and they are then to be so connected that when winding they shall be acted upon together, but when discharging they shall act independently of each other. After the mode of doing this has been described, we are informed that "the barrels may be placed on separate arbors as in common clocks, if desirable," and in this case nothing is said of connecting them so as to wind together, although the winding together is one of the two points claimed; the other is "the method of arranging the stop, by which the machine is simplified." This part is very indistinctly described, and the drawing lends no great aid to the description.

32. For an improvement in the *Door Lock;* James Kyle, city of New York, May 18.

The parts of this lock upon which the patentee rests his claim cannot be accurately described without a drawing, although a general idea of its mode of action may be given. The bolt is shot forward by a spiral spring acting against it, and it is intended to be used as a spring door lock, the bolt being moved by turning a handle in the usual way. The lever on the handle, works in a mortise made entirely through the bolt, which mortise is sufficiently long to allow the bolt to be drawn back, and clear the catch, or box.

Behind the bolt there is a number of flat, thin levers, made of plates of metal, and working on a pin. Each of these has a projecting piece on its end which falls into a notch in the bolt, retaining it in its position. The catch pieces upon these levers differ in length, and they require, therefore, to be raised in different degrees in order to disengage the bolt and allow it to act. The key has on it a number of projecting pieces, or cams, corresponding with the number of levers, each of which is to act upon its proper lever and raise it as a latch is raised. The projecting pieces on the key are formed of thin metallic plates like that of the lever latches; these slide over the shank of the key, and are secured by a nut on its end; this is done for the purpose of giving to them an arrangement corresponding with that of the levers, which all work upon one common fulcrum, and are susceptible, therefore, of an almost infinite variety of changes, the cams also can be so changed as to act with them.

The claim is to the whole of the before described lock, with the exception of the stock, and the spiral spring under the bolt.

Although the principle of a number of levers, or tumbles, falling into notches in a bolt, and the raising them in different degrees by means of the key, is not new, the arrangements by which this is effected in the present instance, we think sufficiently so to become the foundation of a valid claim.

33. For a machine for *Making Brush Handles,* Rake Han-

dles, &c. Evans Tuck, Harrisburg, Dauphin county, Pennsylvania, May 18.

The timber is to be rounded by a tubular plane, equal in length to the handle to be formed. This plane is made of four pieces of stuff, which, when fixed together by suitable bands, form the tube through which the timber is to be forced. Upon each section of the plane there are eight irons, the first of which merely takes the angles off the square stuff, whilst the whole of them, acting in succession, reduce it to a round stick.

This plane is placed at the end of a trough in which the square stick is laid, having behind it a follower or rod, which is forced up by any adequate power, and drives the stick entirely through the hollow plane. The trough may be so high as to contain a considerable number of such sticks, which fall successively into their places as the follower is withdrawn. The patentee thinks that by the application of sufficient power, a stick may be rounded every second.

The power which will suffice to force the stick against thirty-two irons at once must be considerable, and a motion so rapid as that spoken of would create no small degree of heat; too much, we think, for the temper of the irons. The most formidable objection, however, to this machine, we should apprehend, would be its liability to choak, and the difficulty of clearing it out; but it is to be presumed that the patentee has satisfied himself on this point. We have seen sticks and handles of the kind named turned by means of a very simple apparatus; not so rapidly indeed as above indicated, but at the rate, we believe, of at least one in a minute.

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34. For an improved *Winnowing Machine;* James Ruple, Washington, Washington county, Pennsylvania, May 19.

The parts of this machine are generally the same with that of others for winnowing and cleaning grain, and we should think it time spent to little purpose to attempt to point out the particular differences; we shall therefore content ourselves, and, we presume, meet the approval of most of our readers, by giving the claim.

"What I claim as new, and of my own invention or discovery, is the formation of the screen, and the manner of shaking and using it; and the cant boards under the shoe to prevent the grain from scattering."

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35. For a *Machine for Dipping Candles;* John Aborn, city of Trenton, New Jersey, May 19.

A vat is prepared for holding the tallow into which the wicks are to be dipped; it may be made of copper, and of such dimensions as are required in the operation; it is surrounded by a tight wooden box, between which and the vat, steam from a boiler is to circulate, for the purpose of heating it. A reservoir for supplying the vat is constructed, and heated upon similar principles. The main part of the apparatus, however, consists of a frame of any convenient length, and wide enough between its sides to admit the sticks upon which the candles are arranged, and the carriages which support them; the dipping vat stands at one end of this frame. A double rail-way, one placed above the other, extends along the frame; and by means of a windlass, the connected carriages, each supporting a row of sticks, are advanced towards the vat, when they arrive there, the candles are dipped, and placed upon the lower rail-way, and carried back, to be again returned. There is a contrivance for weighing the candles, which consists of a long lever extending from front to back, along the upper part of the frame, and supported on fulcra like a scale beam; several other matters of detail are also noticed by the patentee, as a wicking frame, &c.; in point of detail, however, the description is defective, leaving too much to be re-invented by any one who should attempt to construct the machine with no other aid than that which is afforded by the specification.

The claim is to the before described machine, and particularly to the rail-ways, the balance beam, the carriages, the sliding frames, the slides with catches, the wicking frame, and the lever for hoisting and weighing.

The objection to this form of claim is, that after including the whole machine, it particularizes certain individual parts, which, if the whole arrangement is new, is altogether unnecessary; whilst if the whole is not new, the general claim would endanger the validity of the patent.

Specifications of American Patents.

Specification of a patent for Coating Lead Pipes with Tin. Granted to Thomas Ewbank, *city of New York, May* 18, 1832.

To all whom it may concern, be it known, that I, Thomas Ewbank, of the city of New York, have invented a mode of coating lead pipes with tin, in a more effectual manner than has been heretofore done, and by which the danger attending the use of such pipes for the conveyance of water, and other liquids, is obviated, whilst their cost is but little enhanced; and that the following is a full and exact description of my said invention.

I take the lead pipes, *after they have been drawn to the required size*, and I coat them with tin, either on both sides, or on the inside only, as may be desired. To do this I prepare a bath of melted tin, in a vessel of a suitable form and size, which may vary according to the size of the pipe to be tinned. I regulate the heat of this bath, so that the tin shall continue in a fused state, without becoming sufficiently heated to melt the lead. This may be ascertained either by the use of a thermometer, or by testing it by a piece of lead, or by such a mixture of lead and tin as will fuse at a given temperature: with a little experience, however, a workman will not find any difficulty in accomplishing this object without such aids. When the pipe is to be tinned on the inside only, I cover the outside with lampblack and size, or with any other article which will prevent the action of the tin upon it; I then blow powdered rosin into the pipe. When it is to be tinned on both sides, the rosin is to be blown, or otherwise passed into the pipe, and the outside also is to be sprinkled with it, and it is then ready for the process.

The melted tin should be kept covered with rosin, fat, or other suitable article, to prevent its oxidation, and to aid in the tinning. All that is necessary is then to pass the pipe through the melted tin, which, when the pieces are not of considerable length, may be easily managed by hand; or when of considerable length and weight, a rope and pulley, or any other suitable mechanical contrivance which the workman may prefer, may be resorted to.

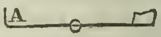
I am aware that the coating of lead pipes with tin, simply, is not new, the same having been heretofore done, but in a manner less perfect than that which I have just described. The lead has been tinned in sheets, and afterwards made into pipes, or the pipes have been made and tinned, and afterwards drawn to the intended size. By neither of these processes, however, is the intended security obtained with the same certainty as by my process of tinning the pipes *after* they are otherwise finished. The coating of tin is thus rendered more perfect, and those fissures are avoided which the former processes can scarcely fail to produce.

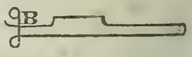
I do not, therefore, claim as my invention the mere tinning of pipes made out of lead, but what I do claim is the tinning such pipes after they have been drawn to the proper size, as is hereinbefore set forth.

THOMAS EWBANK.

Specification of a patent for a mode of detaching horses from a carriage, either when running away, or whenever it may be desirable to effect that object, rapidly. Granted to ROBERT BEALE, *city of Washington, District of Columbia, May* 12, 1832.

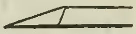
Be it known, that I, Robert Beale, of the city of Washington, in the District of Columbia, have made an improvement in carriages, by which the horses may be suddenly disengaged when running away, or whenever required to be detached from the carriage quickly; called the safety carriage; which is described as follows.





The swingletree is attached to the cross bar by an iron fixture called a jointed clasp, formed as in the annexed figure; the knee part, marked A, resting against the back of the cross bar. This jointed clasp is held up against the underside of the cross bar by an iron shutter, or hinged clasp, formed thus, turning on a joint, or hinge, secured to the underside of the cross bar. To the end of the hinged clasp is attached an iron rod, or bolt, B, with an eye at its end. This rod, or bolt, passes through an opening in the cross bar, and has an iron spring key inserted through the eye, resting on the upper side of the bar, which secures the jointed clasp from dropping; or the rod may be fixed permanently to the cross bar, projecting far enough below it to pass through a slot or mortise in the end of the hinged clasp, with a spring key inserted through the end of the rod, or bolt, to prevent the hinged clasp falling. To the end of the spring key is attached a cord which leads inside of the carriage, where it hangs loosely. Should the horses take fright, and become unmanageable, the cord is then to be pulled suddenly, which will draw the spring key from the eye of the rod, or bolt, let the hinged clasp fall, and with it the jointed clasp attached to the swingletree, and will disengage the horse from the carriage.

The tugs are open in front, thus, to allow the breeching to slip off freely. This breeching is made from a single strap of leather, with rings sewed to the ends, to hook over the tugs.



The shutter, or hinged clasp, may have its end turned up at right angles, and formed like a catch, or hook, and secured by a spring, fastened to the side of the cross bar, the cords being attached to the end of the spring. The shutter may, indeed, be held up in a great variety of modes, but the before described are sufficient to show the principles of my invention.

When it is desired to retain the swingletree, and let the horse go off with traces only, then a hinged clasp must be put on each end of the swingletree, with the jointed clasps secured to the ends of the traces, and the cords attached to the spring keys run through pulleys and are joined to the cord which leads inside of the carriage.

In the two-horse carriage, the shutters, on hinged clasps, are hung on the under side of the wheppletree, and the cords attached to the spring keys run along on the top of the wheppletree in a straight line, then pass around pulleys, and are joined to the single cord which leads inside, or outside, of the carriage. The pulleys are to cause the cords to run freely, and to draw the spring keys, or pins, from the eyes of the rods, or bolts, in a straight line.

An iron tube, with a flanch on one end, is fastened to the end of the pole. Over this is put a thimble, having a ring on each side, to which the breast straps are attached. This thimble slips off the end of the pole, when the horses are disengaged.

The mode of detaching the horses from the two-horse carriage is similar to that described for a single horse carriage.

In a four-horse carriage the leaders are disengaged from the pole in the same manner, by a jointed clasp, hinged clasp, spring key, and cord, as described for a two-horse carriage. The jointed clasp may be held up against the cross bar by a pin inserted through the jointed clasp into the hind part of the cross bar, to which pin the cord is attached.

The jointed clasp may also be secured by a spring fastened on the hind part of the cross bar, the cord being attached to the end of the spring. Springs, or friction levers, are secured to the carriage, and brought in contact with the hub in order to decrease the motion of the carriage when the horses are liberated, or before they are liberated.

This invention may be applied to field artillery, and it will enable the men to limber or unlimber the gun in less than half a minute. It may also be applied to wagons of every description, to ploughs, and harrows, and all kinds of agricultural implements drawn by horses, when required to be taken in haste from the carriage to feed, &c.

A forked piece of iron is suspended over the hound and front axletree to prevent its turning on the body bolt.

What I claim as my invention, and which I wish to secure by *letters patent*, is the before described apparatus for suddenly disengaging horses from carriages.

For a further illustration of my invention I would refer to the models and drawings of the same deposited in the patent office.

ROBERT BEALE.

ENGLISH PATENTS.

Patent granted to GEORGE LOWE, *for an improvement in the manufacture of Gas for Illumination.*

Mr. Lowe may lay claim, and justly, not to one only, but to a series of four inventions, each ingenious and useful, and in combination very valuable.

His first object is to purify the gas—his second, to evolve a greater quantity of a superior quality from the very same proportion of material, and in the very same period of time—his third object, to show the means of securing his first without new efforts—and his fourth is very similarly connected with the second, and includes the application of the whole apparatus to the attainment of the great end.

His stove is of three retorts, the section of each being a parabola. The furnace is as usual; but if, mechanically, his invention be ingenious, it is also chemically profound. He proposes to introduce atmospheric air, heated to 700 degrees of Fahrenheit, or even hotter still, either above, or over the surface of the fuel in the retorts, to bring it in contact with the sulphuretted hydrogen gas cooled from the coking coals in the retort during the process of their decomposition, and with the other gaseous and vaporous exhalations from lime-dreg water, ammoniacal liquor, and other fluids introduced under the furnace. By the combination of the atmospheric air (heated as we have said) with these gaseous evaporations, and their consequent ignition, he produces a sulphuric acid, which, mixing with the pure gas intended for illumination, as it passes the mains, &c. purifies it of those deleterious matters which have hitherto so lessened its brilliancy, equability, and utility. To effect these purposes he has a vessel with lime-dreg water, and one with ammoniacal liquor under the furnace; he has a flue or passage beneath, or at the side of the furnace for the entrance of the atmospheric air, affording the means of heating it to the high temperature we have already stated, and a series of passages from this flue, or tube, into the furnace above the fuel, and over the surface of the burning mass in the retorts. A current of steam is introduced before the gas is conducted to the condenser, and affords, of course, a powerful aid to the purifying agency we have already described.

The second part of the invention consists in having retorts of exactly double the length of those in common use, and capable of being opened at both ends. Suppose, then, that the charge is intended to be one of eight hours, as usual: instead of putting in at once the whole quantity of coal, or coal tar, from which the gas is to be educed, Mr. Lowe would open one end of his retort, and put in exactly half the quantity; then at the end of four hours he would open the other extremity of his retort, and admit the other half. At the end of the next four hours, he would draw half the charge, and this process he would repeat at each end of the retort, alternately every four hours for a charge of eight hours, and every three hours for a charge of six hours. The advantage of this process is, that while every particle of the coal is allowed the same time, and the same means as are given by the common method for its decomposition, the gas evolved from the fresh coal mixes, and is combined with the riper gas from that portion which has had eight hours of burning time, that is, (for we could not be figurative,) eight hours of burning, to breathe out the gas. The coke, after this gas has exuded from it, is submitted to another process, by which all that remains is obtained: and by the interposition of steam, sulphuric or muriatic acid, and the carbonate of potash, the former applied as before described, the latter introduced over the coke in the retort, or the fuel in the furnace, is purified as at first.

The fourth invention is the retort, of its new length and shape; the furnace with its atmospheric air flues, and its troughs of ammoniacal liquor and lime-dreg water; the condensers, with their steam cocks, and inner plates and pipes, and all the apparatus by which the effects we have imperfectly described, are admirably brought about. The gas is purer, in larger quantities, and is produced in the same time, and at a less expense of labour and material, by the inventions of Mr. Lowe; and it is exceedingly probable that the whole, or the greater part, of his improvements will be introduced to general use in all gas works.

[*Rep. Pat. Inv.*

Specification of the patent granted to Moses Teague, *Iron Master, for an improvement in the making and smelting Pig Iron. Dated January* 17, 1831.

To all to whom these presents shall come, &c. &c.—Now know ye, that in compliance with the said proviso, I, the said Moses Teague, do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, is particularly described and ascertained by the following description thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked thereon, (that is to say:)—

This improvement consists in making use of, or employing the flame and heat (heretofore discharged into the open air) from the tops or tunnel heads of blast furnaces or cupolas, used for the making and smelting of pig iron, by means whereof the said flame and heat is made to act upon the ores, mines, and minerals, about to be smelted, previous to the same being deposited into the interior of the furnace or cupola. The material is thereby acted upon with additional heat, which would otherwise pass away without producing effect, and the preparation for smelting so much forwarded as to require considerably less fuel, blast, and time in the operation. The method of applying the same is by diverting the flame and heat (usually passing out of blast furnaces or cupolas, into the open air) and causing the same to pass in, upon, or through, one or more ovens, stoves, buildings, or erections, to be fixed in, or upon, or near to, or adjoining, the tops or tunnel heads of the said furnaces or cupolas; which said ovens, stoves, &c. &c. are made to contain certain portions, quantities, or charges, of the materials intended to be smelted, which, being previously deposited therein, the heat and flame so diverted are made to act thereon. The said flame and heat diverted from its usual course, and driven, or discharged into, or through the said ovens, stoves, &c. &c. by partially contracting, or stopping up altogether, the tops or tunnel heads of the said blast, furnaces, or cupolas, either permanently with brick, mason's work, or any other mode, or by one or more moveable dampers, doors, or valves, to be fixed on, in, or upon them, or the said ovens, stoves, &c. &c. By this means the flame and heat is diverted, and caused to pass into, or through, the ovens, or stoves, which have one or more chimnies, or flues attached thereto, in order to carry off the superfluous heat, flame and sulphur.

The shape, size, and number of the said ovens, stoves, or chambers for containing the ore, mine, or mineral, might be varied according to the size of the furnace, or cupola, and the quantity of materials used in each load or charge, but the more surface can be obtained (provided a sufficient quantity of heat and flame can be brought to act thereon,) the better, as the materials to be smelted can be more thinly spread, and, consequently, present a greater surface to be acted upon by the said heat and flame.*

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* In the Repertory of Patent Inventions, for July last, from which the above is abstracted, there are drawings exhibiting various modes in which the patentee intends to carry his plan into effect, to which we must refer those interested.

Patent to W. Hale, *Machinist, for improvements in machinery for Propelling Vessels, granted October* 13, 1831.

The improvements in propelling proposed by Mr. Hale, consist in driving water forcibly out at the stern of the vessel under the water line, by means of a rotatory apparatus, somewhat similar to the rotatory blowing and winnowing machines.

In the 5th volume of the present series of the Register of Arts, p. 67, we have given a description of a patented invention of Mr. William Hale for raising or forcing water for propelling vessels, and the present patent has been taken out for a modification of the same method, therefore we refer our readers to the former description to obtain a general idea of the plan.

In his second patent Mr. Hale makes the exterior casing of the paddle box to recede from the centre spirally, constituting a curve whose distance from the centre of motion at its outer extremity exceeds the distance at its inner extremity by the space or opening made for the escape of the water from the box. The water is admitted into the box through openings near the centre, in the manner usually adopted for the supply of air to the blowing machines. The propeller, or vane, which puts the water in motion through the medium of a steam engine, or other first mover, consists of a single lever receding spirally from the axis, or centre of motion. The motion of the vane is in the direction to cause the water within the box to recede from the centre, and escape finally in a direction which is a tangent to the curve; or its motion is towards its back, or that part farthest from the centre. The patentee does not, however, confine himself to the spirally formed vane, but proposes several other modifications of the moving or propelling part of his invention; such as placing a series of oblique paddles, or propellers, on arms extending from the centre of the apparatus, as in his former patent; and these he again proposes to vary, according to circumstances, in number, magnitude and position.

This propelling apparatus is placed near the stem of the vessel, with the axis in a vertical position, and the opening at the circumference of the paddle box made to communicate with the water in which the vessel floats through an opening in the stern, while the openings near the centre of the box are made to communicate with the exterior water through the bottom of the vessel.

The application of the invention to raising or forcing water, is effected by connecting the induction openings with the well or reservoir from which the water is to be raised, and a delivery pipe with the eduction opening, and thus the machine becomes a rotatory pump. [*Reg. of Arts.*

Patent to R. W. Sievier *for improvements in the manufactory of Cables, Ropes, Lathe Bands, &c. granted December* 1, 1831.

The ingenuity of this patentee has been developed much more extensively in finding applications for his invention than in the invention itself, which simply consists in the application of strands of caoutchouc, or Indian rubber, instead of strands of hemp or flax, in the manufacture of ropes. The Indian rubber is to be separated into slips of appropriate dimensions, and then drawn out till they are reduced to the thickness required for a strand. Seven, or any other convenient number of the strands, are then placed together longitudinally, and secured together by hemp, flax, cotton, woollen, or other fibrous substance, or by straps of leather, or other suitable material, being woven, knitted, netted, or plaited over the Indian rubber strands. In the manufacture of larger cordage, seven, or any other convenient number of the last are to be bound together in a similar manner, and then as many of this second size are to be united as shall make a cable, if required.

The other purposes besides the cables, ropes, whale fishing and other lines, to which this invention is said to be applicable, are travelling bags, purses, or similar articles, where the difference of the magnitude of their contents renders elasticity in the containing bag of importance. [*Reg. of Arts.*

Specification of the patent granted to John Samuel Dawes, *Iron Master, for certain improvements in the manufacture of iron. Dated December* 22, 1831.

To all to whom these presents shall come, &c. &c.—Now know ye that in compliance with the said proviso, I, the said John Samuel Dawes, do hereby declare the nature of my said invention, and the manner in which the same is to be performed, (that is to say:)—

My improvements in the manufacture of iron are applicable to the processes of smelting, remelting, &c. and consist of, or in, the introduction of certain materials at the bottom or lower part of the blast furnace or cupola, and in continuing such introduction during the above mentioned operations of smelting, remelting, &c. in addition to the usual method of charging the said furnaces at or near the top or tunnel head, by which means I consider that I am enabled to make a larger quantity of iron, of superior quality, with a less quantity of fuel, and with less expensive materials than are commonly used, such as coal uncoked, iron-stone untorrified, &c.

The materials which I use (at the lower end of the furnace,) consist of charcoal, or any other fuel applicable to the purpose, together with any of the well known fluxes, such as alkalies, alkaline earths, lime, metallic, or other, oxides.

The means by which I now effect the introduction of the said fuel and other substances, consist of a conical tube, or feeder, (into which the said materials are thrown,) fitted to the top, and projecting a little behind the mouth of each blast pipe, (the blast pipes being in the usual situation,) which tubes, or feeders, together with the said blast pipes, communicate with the furnace through large water tuyeres or tue irons, or they may be introduced at any other part of the lower end of the said furnaces, as shall be found best suited to the purpose. [*Rep. Pat. Inv.*

Patent granted to PIERREPOINT GREAVES, *for making ornamental or fancy Cotton Yarns and Threads, applicable to the making, sewing, or embroidering of Cotton, and other Fabrics. Dated December* 22, 1831.

The skilful combination of the primary colours, so as to produce new shades or self-colours, has proved a puzzling point for the dyer; nay, it is held impossible, by a mixture of dies to produce certain tints in cotton. It is of some importance that this difficulty should be got over; silk embroidery and worsted tapestry, have long been foster sisters to painting; woollen rags have been dexterously made into pictures, and tattered red coats are manufactured into a brilliant tint, but the arts of design have received few favours from cotton, while Manchester and Glasgow know how much cotton owes to the ornaments with which art has loaded it. Now, there is reason to hope from this discovery of Mr. Greaves, that the minutest shades of colour may be produced in cotton yarn and thread; and that future tapestries and brocades, and embroideries, and tambourings in this elegant material, may be manufactured with all the advantage of varied tints, as well as all that grace of *drawing* which some productions in cotton have already manifested. This discovery is not only ingenious and useful, but it is capable of an easy explanation, and may be made clear in few words, with little trouble to the understanding. Mr. Greaves procures a quantity of cotton wool, dyed as usual in each of the primary colours, and without the aid of any machinery, without the slightest additional expense, with no more than the common quantity of labour, he produces his novel and variegated store. He uses the wool as a painter would do the earths, which are called colours from the colours they bear. He takes, for instance, a portion of blue wool of a deeper or a lighter shade, and a portion of pink wool, and mingles these together until the mass is purple, adding red or blue according to the tone he seeks. If he wish to produce a delicate green, he uses a proportionate quantity of blue and yellow; these colours he can make darker or lighter by the addition of a deeper blue up to black, and a paler pink or yellow down to white, for white and black wool may be mingled with the prismatic coloured wools just as they may be with the primary colours in the earths for painting. When he has brought his mixture to the tone he wants, he deals it out to the spinner in the usual quantities, and after it has gone through the common process, and is made into yarn or thread by the usual means, it retains that tint which the wool acquired by its regular admixture; and thus any work of weaving or sewing in tapestry, tambouring, or embroidery, may be wrought in cotton with the highest degree of perfection.

To copy the finest painting, in cotton, is no longer a matter of insuperable difficulty; and as the task must be delightful, we may well expect some new Miss Linwood to give her attention to a subject so interesting. It is a matter wholly in the hands of the ladies. If a picture be fairly studied—one of the Madonas of a Raphael, for instance—and the necessary colours and shades, and tints noted, and sent to Mr. Greaves, he would no doubt furnish the required quantity of material in the due proportions, and by dint of talent and industry an excellent copy might be produced.

Again, in dresses, what improvements may not be wrought when the trimming and the dress are of the same fabric. In furniture for the bed room, or the sofa, or the chair cushion, what elegant devices may be adopted. The designs of Flaxman, in the frames of Corbould, may yet shine in cotton colours on a music stool, blending nearly all the arts. In shawls, too, how much delicacy will be gained by the new self-colours, and how rare the tints thus to be produced. What enamel is to painting, cotton tapestry may be to that of woollen. We shall have arras hangings again in all probability; at least the *agrémens* of the boudoir may be heightened by this discovery of Mr. Greaves. The new tapestry should be called Pierrepoint. [*Rep. Pat. Inv.*

Patent granted to Claude Marie Savoye, *for improvements in Mills for grinding and reducing Grain. Communicated from abroad. Dated December* 15, 1831.

The inventor desires you to suppose a large solid ring, or hoop, of cast iron, or other metal; it is to be straight and equal on its outer side, as if part of a cylinder, but inside bevilled, or inclined as if a section of a cone: on the upper part of the inside of this ring is cut a series of sharp teeth, which project considerably at their points, and taper down, till they become smooth and equal with the common surface of the metal; or, to use the workman's phrase, quoted in the specification, "diminish till they terminate in nothing." Just at this point, however, there are small gutters, or channels, cut in the iron, at the root of each tooth, and at an angle of inclination; these are to allow the bran or residuum of the corn to pass away, and also to admit air. To the lower edge of this ring are attached "lugs" or ears of solid metal, by which it is to be secured horizontally into a timber frame, of great solidity. This ring represents the nether mill stone. A second ring of the same metal and of equal solidity, but of a less diameter, and of a conical shape, outside, where a set of teeth, corresponding with those of the inner circle of the last described ring, are cut, is made to fit into and act concentrically within it. The serrated sides work against each other, the teeth being, therefore, of course, set differently, those of the inside of the large ring turning their points one way, those on the outside of the smaller ring turning their points in the opposite direction.

The action is rather cutting than molar, and resembles that of a pair of scissors, more than that of mill stones. However, these rings supply the places of grinders. When the outer circle has been securely fastened by its lugs, or ears, to the beam, or frame of timber we have mentioned, a spindle, or axis, is secured into the centre of the inner ring. It works in a tube, or case, which passes upwards to where an extinguisher-shaped cap surmounts the whole, and downwards to its resting place on a lever, by which the degree of contact between the two rings is regulated. For it stands to reason that very coarse grain might lift the inner ring out of its position, and very fine grain might pass between the rings unground. This is prevented by the lever we have spoken of, the fulcrum of which is a part of the frame work, and which lifts the inner circle out of its position when it is too close to the outer ring, and brings it down again when forced up. To secure it in this latter position there is also a screw to confine its action, and in the tube through which it works, and to regulate its velocity at the same time. Over the extinguisher-shaped cap we have named, is a sort of inverted seive or cylindrical hut, which is the upper covering, and between which and the cap is kept the grain to be reduced, and there its entrance between the rings is equalized.

Another part of the invention is to surround the metal wheels with *annula*, or circular trenches of cold water, keeping the metal cool, and preventing the corrosion of the wheels, and combustion of the grain. This must be a necessary adjunct to every mill whereof the grinding parts are of metal, and although the idea is originally ingenious, the application is manifestly of extreme simplicity. A constant supply of water, and a constant drainage, as it becomes heated, are all that is required. Now as to the power by which this mill is to be wrought, a drawing accompanies the specification, not only of each of the rings, and of a section of the chief parts at work, but of the whole machine. In this the power is by a winch and fly wheel, with the means of adding any supplemental gear to increase velocity. A man's hand is the power, and a crank turning the spindle we have described, causes a partial revolution of the inner ring, and the revolution can be made complete if necessary. Although perfect rotation is not so suited to the invention as a vacillatory or alternate motion, the supposed advantages of this invention are the saving of expense, strength, and economy of space. The application of water is claimed as new, the toothed rings are claimed as new, and there is added a diagram to show that any number of rings may be made to act in the manner of the two described, by which the whole mill would be a series of concentric circles, acting on each other, fed in the same manner, watered also for coolness, and moved with almost the same power.

As a malt mill it appears exceedingly well adapted, and it might be made small enough for a coffee mill, or a pepper mill. To these latter uses we have seen a very similar principle applied.

[*Rep. Pat. Inv.*

Patent granted to Abraham Adolphe Moser, *Engineer, for improvements in certain descriptions of Fire Arms. Dated December* 15, 1831.

This new way of firing muskets, fowling pieces, and pistols, requires a very different mode of loading, and a different sort of lock from those in use at present. The object is to ignite the powder at once by a flame of considerable size within the chamber, and without the narrow passage, or touch hole, which is easily stopped up, and gives out a small line of flame to the powder instead of a broad sheet as it ought to give. No priming, therefore, no percussion caps, are used by Mr. Moser.

His next object is to save time, and prevent the necessity of ramming down the cartridge. It is possible, nay necessary, according to his plan, to make the cartridge so much less in diameter than the calibre of the barrel, as to allow it to run home instantly, by merely dropping it into the muzzle; and to keep it in its place till fired, and give it the force it gains from confinement, a small pin or plug dependent on the trigger guard, contracts the space of the barrel to that of the cartridge by a single motion, and keeps it in its position till the trigger being pulled allows of its escape.

Now the mode of combustion is by a small pellet of detonating mercury secured to a common piece of card wadding, and forming the inner end of the cartridge. This by way of priming. Instead of flint and steel, there is a long pin, secured within a sheath, and moving through the powder chamber by means of strong springs. When the gun is loaded, and the cartridge secured, this pin is quiescent in its sheath; but when the trigger is pulled, the springs expand and force the pin beyond its sheath, to the detonating pellet on which it acts, causing explosion, and creating a sheet of flame within the chamber which is exposed to the powder, ignition takes place, and the gun goes off, the finger is removed from the trigger, the springs recoil, and the pin returns to its sheath till another cartridge is introduced, and it becomes necessary to repeat the action.

The lock is very ingenious, but it is very difficult, perhaps impossible to be described accurately without a marked drawing; the principle, however, is such as we have stated it.

The means of producing the effect by the aid of the pin and the springs, can be very readily conceived, but we confess that the arrangement of the parts is not clear to us after the most careful study of the specification, and we will not attempt to explain what we cannot comprehend. The plug, or stop, by which the cartridge is retained, appears to us a dangerous expedient, and the trigger guard as figured in the drawings is awkward. Neither is the ram-rod dispensed with, though not used in loading the piece.

[*Rep. Pat. Inv.*

Notice respecting the production of Electric, or Magnetic Sparks, from the common Magnet.

"Palmam qui meruit ferat," has always been a favourite motto of ours, and whilst we are ready to award the highest praise to Mr. Faraday for his assiduous, indefatigable, philosopher-like pursuit of the subtle principle and peculiarity of electricity, and of his proofs of the affinity (or identity?) between it and magnetism; and whilst we are equally prompt to bestow our meed of approbation on Dr. Ritchie, for his advancement of the same object, we must offer the palm of perfect success to Mr. Saxton, an ingenious native of Philadelphia, now residing in London, as the original demonstrator of the capability of eliciting a spark from the common magnet. To do this, we must first refer to the Minutes of the Royal Institution.

On the 11th of May, Dr. Ritchie, Professor of Natural Philosophy, stated to the Institution, that he had followed in the track of Mr. Faraday, in his late brilliant discoveries, and was happy to say that he had uniformly arrived at the same conclusions. He had also succeeded in making the spark, which had been obtained by Mr. Faraday in breaking the magneto-electric circle, visible to a large assembly. This was done by placing an explosive mixture of oxygen and hydrogen in the course of the spark, which immediately produced a loud report and a flash of light. He employed a horse-shoe magnet, between the ends of which were placed a couple of tubes; a wire was introduced into each, and their connexion maintained by a conducting medium. The wires were connected to the magnet by the folds of copper riband. The gas was introduced by a bladder and stop-cock; the contact suddenly broken; and the spark made evident by an explosion. Dr. Ritchie declared his belief that no such spark could be elicited from any but a *temporary* magnet.

At this time Mr. Faraday came forward and stated that he had succeeded in obtaining a spark from a *natural* magnet. Mr. Faraday had borrowed Brown's magnet from the academy at Woolwich. A small bar of iron, about six inches long, was used in contact with the extremities of the magnet. Two connecting wires were taken from each end of this small bar, and being bent at right angles, overlapped each other. The undermost terminated in a disc, about the size of half a crown. By a rapid percussion of the bar against the magnet, the disc and wire broke, in contact, by their electricity, and a beautiful bluish spark was produced.

Now, dates are very important to the identification of a discovery, and it is upon these, and upon concurrent testimony, that we rely in support of our conceding to Mr. Saxton the merit of the earliest demonstration of these interesting phenomena in England. It was on the second day of May, that Mr. Saxton first produced an electric (?) spark from a common magnet of very great power, which he was then constructing for exhibition at the New Gallery, in Adelaide street, Strand; and on that, or the following day, the experiment was repeated in the presence of Dr. Ritchie, who declared it to be the only one he had witnessed. After some trifling improvements had been made by Mr. Saxton, in the apparatus used for breaking the continuity of the subtle fluid, he succeeded in causing the explosion of gunpowder, a much less inflammable material than that used by Dr. Ritchie, from ignition by the spark, which we have, since then, seen him repeatedly perform. Does Dr. Ritchie call Mr. Saxton's magnet one of the *temporary?*

We subjoin a description of the magnet constructed by Mr. Saxton. It is called a horse-shoe magnet, (very elongated,) and is formed of eight shear steel plates, twenty-eight inches in length from the poles to the centre edge, three inches wide, and forming together a thickness of two inches and a half; at the greatest width of the curvature it measures nine inches, and at the poles seven inches across; the poles have a return inwards, towards each other, and are there separated by a space of one inch and a half. The keeper, or lifter, which is made of the purest soft iron, is four inches long, one inch and a quarter wide, and one thick. Around the middle of the keeper, and occupying with its lower section the space between the poles, is a wooden winder, having about one hundred yards of common bonnet wire, threaded, from which the two ends, composed of four lengths of the wire, twisted together, are carried out, with a vertical curve of about three-fourths of a circle, one of these twisted ends passing beyond each end of the keeper, and resting upon the respective poles of the magnet. A small wooden lever is so fixed to the winder and keeper as to admit of the whole being suddenly forced up from the magnet by a smart stroke; and a very beautiful and brilliant spark is invariably elicited, at whichever end of the wire is first separated from the magnet.

It is Mr. Saxton's intention to add several plates to his magnet, and to ascertain, by a series of experiments, the best size for the keeper—the best description of wire to be used—the easiest mode of causing an instantaneous separation of the wire from the magnet, and other interesting consequences, the result of which we shall take occasion to communicate to our readers. [*Lond. Paper.*

On the utility of fixing Lightning Conductors in Ships.

[Continued from p. 205.]

12. Although the application of lightning conductors to buildings on shore is always judicious, and their advantages very apparent, yet on ship board, where the effects of lightning are most to be dreaded, the introduction of this means of defence has been slow and imperfect. The conductor hitherto employed at sea consists of long flexible chains, or links, of metal, about the size of a goose quill, sometimes of iron: those employed in H. M. Navy, however, are of copper; they are usually packed in a box, and are intended to be set up from the mast head to the sea when occasions require, so that, as

observed by Mr. Singer in his excellent work on electricity, partly from inattention, and partly from prejudice, they frequently remain in the ship's hold during long and hazardous voyages quite unemployed; a remark, the truth of which is but too frequently verified in the damage so constantly happening at sea during lightning storms.*

13. The necessity of providing the best possible security against the effects of lightning on ship board has been long admitted, but continuous and fixed metallic rods have been deemed inapplicable to ships, in consequence of their masts, the only parts to which they can be attached, being exposed to chances of injury, to motion in a variety of ways, to frequent elongation and contraction, and to the necessity which frequently arises for removing the higher masts altogether, and placing them on deck. It was probably from these causes that the small flexible chains, or links, above mentioned, were employed. Such conductors, however, will probably, on examination, be found less applicable than fixed continuous lines of metal, and, in every point of view, inefficient substitutes for them. Their great want of continuity, as well as their want of mass and surface, is very unfavourable to the transmission of severe explosions, the electric matter becoming sensible at the points of juncture, as is evident by the sparks which appear upon them at the time of the discharge, so that in some instances they have been actually disunited: they are likewise objectionable as being liable to every species of injury incident to a ship's rigging, and much difficulty is experienced in keeping them in their position, and unbroken, more especially during gales of wind, and at night, when the ship is under sail, and when it is perhaps required, as is already observed, to remove some portion of the higher masts. It has therefore been long considered desirable to apply, if possible, a permanent conductor, which should be always in its place, and ready for action; and various attempts have been made, and suggestions advanced, at different times, to apply fixed lightning conductors in ships, as the subject from time to time has demanded further consideration.

To protect a ship effectually from damage by lightning, it is essential that the conductor be as continuous and as direct as possible, from the highest points to the sea—that it be permanently fixed in the masts, throughout their whole extent, so as to admit of the motion of one portion of the mast upon another; and, in case of the removal of any part of the mast, together with the conductor attached to it, either from accident or design, the remaining portion should still be perfect, and equivalent to transmit an electrical discharge into the sea.

15. To fulfil these conditions, pieces of sheet copper, from one-eighth to one-sixteenth of an inch thick, and about two feet long, and varying from six inches to one inch and a half in breadth, may be in-

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* Case (*f.*) p. 204. The conducting chain, at the time of the first explosion, was stowed away in its box below, although set up in time to prevent the effects of the second explosion. A minute account of this will be found on referring to vol. iv. (old series) p. 197, and vol. ii. (new series) p. 63.

serted into the masts in two laminæ, one over the other; the butts, or joints, of the one being covered by the central portions of the other. The laminæ should be rivetted together at the butts, so as to form a long, elastic, continuous line; the whole conductor is inserted under the edges of a neat groove, ploughed longitudinally in the aft side of the different masts, and secured in its position by wrought copper nails, so as to present a fair surface. The metallic line thus constructed, will then pass downward from the copper spindle at the mast head, along the aft sides of the royal mast and top-gallant mast, being connected in its course with the copper about the sheeve holes. A copper lining in the aft side of the cap, through which the top-mast slides, now takes up the connexion, and continues it over the cap, to the aft side of the top-mast, and so on, as before, to the step of the mast. Here it meets a thick, wide, copper lining, turned round the step under the heel of the mast, and resting on a similar layer of copper, fixed to the keelson. This last is connected with some of the keelson bolts, and with three perpendicular bolts of copper, of two inches diameter, which are driven into the main keel upon three transverse, or horizontal, bolts, brought into immediate contact with the copper expanded over the bottom. The laminæ of copper are turned over the respective mast heads, and secured about an inch or more down on the opposite side; the cap which corresponds is prepared in a similar way, the copper being continued from the lining in the aft part of the round hole, over the cap into the fore part of the square one, where it is turned down and secured as before, so that when the cap is in its place, the contact is complete. In this way, we have, under all circumstances, a continuous metallic line, from the highest points to the sea, which will transmit the electric matter directly through the keel,* being the line of least resistance.

16. From what has been already observed, it will be apparent, that, in whatever position we suppose the sliding masts to be placed, whether in a state of elongation or contraction, still the line of conduction will remain perfect, for that part of the conductor which necessarily remains below the cap and top, when the sliding masts are struck, is no longer in the line of action, consequently its influence need not be considered.

17. The following table exhibits the mean proportion of a conductor thus constructed on one mast of a fifty gun frigate, as compared with the copper links usually furnished to the British navy, together with the necessary equivalent in copper or iron bolt, in order to obtain a conductor of the same mass.

The resulting quantities in the last line at the bottom of the table, represent, with the exception of the proposed conductors, the masses, surfaces, and diameters, of cylindrical metallic rods, supposed to extend the whole length of the mast. Thus in column 2, we have the diameter and surface of a copper rod, containing 2423 cubic inches of metal, being an equal quantity of matter to that in the proposed conductors, and from which it is calculated. The sums, therefore, are not the result of the addition of the successive masts. The same may be observed in column 3; taking the equivalent in iron. In the third and fourth columns, we have the mass and surface of a copper rod of half an inch in diameter, generally allowed to be adequate to any shock of lightning yet experienced: and, lastly, in column 4, we have the mass and surface in the conductors now furnished to the British navy; which we find, as compared with the mass in the proposed arrangement, is only as 94.4 : 2423.

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* Since the mizen-mast does not step on the keelson, it will be necessary to have a metallic communication at the step of the mast with the perpendicular stancheon immediately under it, and so on to the keelson, as before, or else to carry the conductor out at the sides of the vessel.

Table.

SUCCESSION OF MASTS.	Proposed conductors.		Equivalent in a copper rod.		Equivalent in an iron rod; taking conducting powers only as 4 to 1.			Mass and surface in a copper rod of 1-2 in. diam.		Mass and surface in present conductors.	
	Mass.	Surface.	Diamet'r.	Surface.	Mass.	Surface.	Diamet'r.	Mass.	Surface.	Mass.	Surface.
	cubic in.	sq. in.	in.	sq. in.	cubic in.	sq. in.	in.	cubic in.	sq. in.	cubic in.	sq. in.
Royal Pole. Conductor 18 ft. 3 in. long, 2 in. wide; two laminæ, each 1-16th of an inch thick.	54	1752	.56	385	216	770	1.12	42	343	10.5	171
Top-gallant mast. Conductor 17 ft. long, 2½ in. wide; two laminæ, one 1-8th of an inch thick, the other 1-16th.	95	2040	.77	493	380	986	1.54	40	320	10	160
Topmast. Conductor 50 ft. long; copper 4 in. wide; two laminæ, each 1-8th of an inch thick.	600	9600	1.1	2070	2400	4140	2.2	117	942	19.2	471
Lower-mast. Conductor 93 ft. long; copper 6 in. wide; two laminæ, each 1-8th of an inch thick.	1674	26784	1.38	4837	6696	9675	2.76	219	1753	54.7	876
	2423	40176	1.2	8064	9692	16128	2.4	418	3358	94.4	1678

18. The manner in which the conductors here proposed, are applied to the mast, gives to the whole the form of a flattened, conical surface,—wide at the base, and diminishing gradually to a point.

It has been stated by one of the most eminent of the French philosophers, that this form is the best possible for a lightning rod.

19. The objections made to fixing lightning conductors in ships, are, for the most part, such as have been urged against lightning rods generally, and are principally as follows:—It is said that by fixing continuous lines of metal in the mast, we *invite* an electrical discharge from the atmosphere, and that by means of an attractive power, which, it is assumed, the metal is possessed of, the explosion is drawn exclusively upon the vessel; that, inasmuch as we can never ascertain the absolute quantity of electric matter which may be discharged from a thunder cloud, it is possible that the transmitting power of any conductors we can apply, may be inadequate to the end in view, so that they may possibly become fused; and hence it is inferred that much damage may be the consequence:—That in fixing lightning conductors in the masts, we can only have *surface*, whereas, the properties of a conductor depend on the *mass*, and not on the *surface* of the metal: hence the metallic surface is calculated to do considerable mischief, by conducting the lightning into the body of the vessel. Such are the principal objections to this application, and which, it is hoped, are fairly stated. They are well deserving serious consideration, but they will be found, on examination, to be inconsistent with experience, and with the known laws of electrical action. We shall, however, by a candid enquiry, give these objections all the attention which their connexion with so important a question demands.

20. The notion that a lightning rod is a positive evil, will be found to have arisen out of the fact already mentioned, (8) namely, that lightning invariably passes through the line, or lines, of least resistance between the points of action; hence it seizes on all those substances which oppose the least resistance to its passage; metallic vanes, vane spindles, iron bars, knives, and pointed metallic bodies, generally, will therefore be very commonly found in the course of the explosion; and from this circumstance, they have been considered to exert an attractive force upon the matter of lightning, so as to draw it aside from its destined course to the destruction of the substances in connexion with them.

21. It will be found, however, that the action of pointed metallic bodies is purely passive; that they only afford, by the aptness of their parts, an easy transmission to the electric matter; so that they can no more be said to attract the matter of lightning, than a dike can be said to attract the water which necessarily flows through it at the time of heavy rain; and, as in the one case, the water is drawn down by a force not peculiarly appertaining to the dike, so, in the other case, the electric matter is determined to a given point, in a somewhat similar way, by a force not appertaining to the metal. More-

over, it may still further be reasoned by analogy, that, as the quantity of water transmitted will depend on the capacity of the dike, and the final protection it gives in conveying the fluid, on the length to which it is continued, so, on the other hand, the protection afforded by a lightning rod will also depend on *its* capacity, and the distance to which it runs. If, in both cases, the length be extended until the force in action be satisfied, the protection received will be as the capacity for transmitting the current: if both be perfect, the protection will be complete; if the dike be not present, the water must be supposed to run loose and undirected; or, if its continuity be frequently interrupted, or narrowed to a small compass, the damage must then be supposed to happen in the intermediate spaces. Such is, in fact, the way in which all bodies of the conducting class already mentioned, (4,) operate in conveying electrical discharges; and it must never be forgotten as an important feature in this discussion, that, whenever we erect an artificial elevation on the earth's surface in the ordinary way, we do in fact, set up a conductor of electricity, upon which the electricity of the atmosphere will fall, and no human power can prevent it. Hence, if metallic bodies be present, those will be first assailed; if not, then the electric matter will fall on the bodies next in conducting power, and so on.

22. A curious illustration of this principle, will be found in an extract from the Memoirs of the Count de Forbin, which is given in the 48th vol. of the Philosophical Transactions. "In the night," says the author of these memoirs, "it became extremely dark, and it thundered and lightened dreadfully. As we were threatened with the ship being torn to pieces, I ordered the sails to be taken in. We saw upon different parts of the ship above thirty St. Elmo's fires; amongst the rest there was one upon the top of the vane of the mainmast more than a foot and a half in height; I ordered one of the sailors to take it down. When this man was on the top, he heard this fire; its noise resembled that of fired wet gunpowder. I ordered him to lower the vane and come down, but scarcely had he taken the vane from its place, *when the fire fixed itself upon the top of the mainmast*, from which it was impossible to remove it."

23. Since, then, the conducting power of bodies differs only in degree, and that the action by which they are assailed, is the result of a great natural agent quite independent of them, we may expect to find all bodies liable to be assailed by lightning, though the effects may be most apparent when the conducting power is imperfect. Thus we find cases on record, of ships struck by lightning, in which no metallic spindles were present, or other iron work about the mast head;* moreover, it is by no means an uncommon circumstance to find trees and rocks rent asunder by lightning, and to hear of men and quadrupeds, even in a plain and open country, destroyed at the

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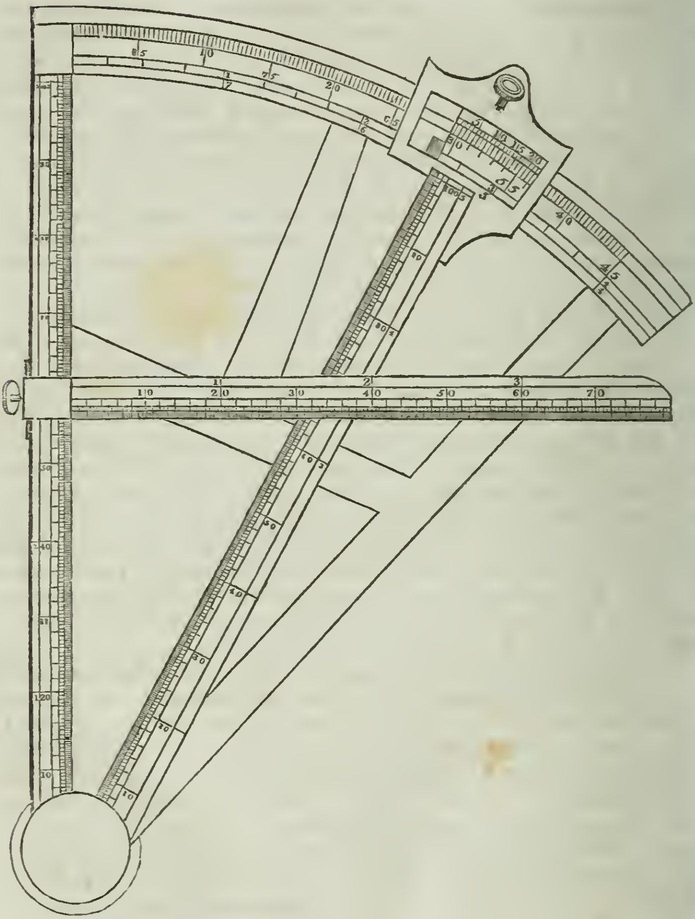
* See Philosophical Transactions, vols. xlix. and lxix., damage done to the sheer hulk at Plymouth, and on board the Atlas, East Indiaman.

time of a thunder storm, when the electric matter strikes the earth's surface. [*Rep. Pat. Inv.*

Crow's Seaman's Octant and Traverse Worker.



The land surveyor has his sliding rule; why should not the navigator also have his instrumental calculator? Mr. Crow, late of

Gravesend, now of London, has furnished an admirable answer to this question, in the octant and traverse worker, shown on the last page. The construction of the instrument is so simple, and its utility so very obvious, that we wonder something of the kind has not been invented before. Seamen work their reckoning at present with the help of printed tables of sines, tangents, &c., which are calculated on the principle, that the sine, tangent, and secant of every angle correspond with the sine, tangent, and secant of the circle which measures that angle, and that the sides of the angle are in the same proportion, one to another, as the sines of the opposite angles. Mr. Crow's octant does this work for them mechanically, and with an accuracy to which no pen and ink, or printed calculations, can possibly pretend. The instrument is of a triangular form, each of the three sides representing the sine, tangent, and secant of the opposite angle. The arc is graduated to 45 degrees, which are subdivided by a vernier into minutes; in the ordinary traverse tables, degrees only are given. The following additional explanations we extract from a small descriptive treatise by Mr. Crow, which accompanies the octant:—

"There is a double row of figures to the degrees, to denote angles and their complements in either case; that is, when the angle is less than 45 degrees, the lower row become the complement of the given angle, and the contrary—only that the minutes found on the vernier are to be subtracted from 20′, and the difference added to the complement will be the degrees and minutes greater than forty-five degrees. When the given angle is less than forty-five degrees, the index is to be placed over it on the arch, in the usual way. Observe always to count from left to right when the angle is less than forty-five degrees, and from right to left when it is more than forty-five degrees. The same observation applies to the scale of rhumbs or points, which are immediately below; for if the course be three points, it shows at once its complement, five points underneath; and if five points be the given course, then the difference of latitude is found on the slide, and departure on the divided limb. Now for the three sides of the triangle—

"First. The diff. of lat. is on that side upon which the slide traverses; and it is also called the divided limb. Here the diff. of lat. is always to be found or laid off, if the course is not more than four points, or forty-five degrees.

"Second. The dep. is the slide, and traverses up and down; upon which the dep. is always to be found or set off, when the course is not more than four points, or forty-five degrees.

"Third. The distance or index. On this side of the triangle the dist. is to be found in the angle of intersection with the slide.

"With respect to the diff. of lat. and dep. one general rule must invariably be observed—it is this: That when the given course is more than four points or forty-five degrees, these sides change names; and so they always do when the diff. of lat. is less than the dep. For if it be a five point course, the diff. of lat. is then to be found on the slide, and dep. on the limb; and the same is to be observed when the diff. of lat. is less than the dep.; that is, set off the diff. of lat. on the slide, and the dep. on the limb, when these are given to find course and dist.; and the angle of the course thus produced will be found on the arch, and must be read off from right to left, as it will be more than forty-five degrees.*

"Fourth. To find or set off any required number on the sides of the triangle on the common scale, No. 10 to 100 on the limb and index, and to 75 on the slide. Required that the slide should be placed to 53.2 on the diff. of lat. or limb. First, find 53; then take the first subdivision next to this last, is $\frac{2}{10}$; to this place the edge of the slide, and you will then have on the diff. of lat. side 53.2, the number required. But this number may be called 53.20, thus bringing out the result to two decimal figures, which is equal in accuracy to the table of logarithms, only with this great advantage, that the results are had by the instrument tenfold easier and quicker. The same numbers may also be counted 532. Now the large scale is numbered 1 to 5 on the two longest sides, and 1 to 3 on the slide. This scale is convenient when working for the meridianal diff. of lat. as it frequently happens to run up to thousands. If short boards are made, as two to six miles, which often happens in light airs and calms, any distance is readily set off, and the corresponding results expeditiously obtained. Now to suit our convenience, we may assume the first 10 on either of the sides, on the common scale, as one or unity, and 20 above, as 2, 30 as 3, &c.; then will the first division, which is cut up to the second line, be $\frac{1}{10}$, and the longer division $\frac{2}{10}$, &c. &c. In like manner may the first 1 on the large scale be assumed as 10, 2 as 20, 3 as 30, &c.; then will all the longer divisions from 1 to 2, be each 1, or unity, and the subdivisions between these will each become $\frac{1}{10}$. Also may the 1 on the large scale stand for 100, 2 for 200, &c.; the subdivisions then are 1 each. Now admit the distance run to be six miles on a S. W. by S. or three-point course—place the chamfered edge of the index to 3 on the arch, then bring the slide to cut 60, which now stands for six miles, the dist. run, and it is done. On the limb is 5′ for diff. of lat., and on the slide is 3′.3, or a little more, for the dep."

The treatise from which we have made the preceding extract, contains also numerous examples of the mode of calculating by means of the instrument; and these are so distinct and clear, that he must be a dull sailor indeed, who after reading and working them, should find himself at a loss to resolve, by means of the octant, any case whatever in practical navigation.

We should think it a matter of regret, were this instrument to supersede altogether what Jack calls head-work; but, we apprehend, it is quite as likely to lead him to the sufficient reason, in most cases, as the means he at present employs. Of books, there is a mechanical use, as well as there is of instruments. To what Mr. Crow says on this head, every inquisitive landsman who has traversed the deep sea, can bear witness.

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* To work and read off by this instrument, it is intended that the heel, or angular point, should be towards the body.

"How few among that useful class of men, plain practical sailors, are able to go to any extent into the basis of the science of navigation, and who continually are working their various problems without ever thinking further than that they are to add together certain numbers, and subtract others; and that if they do this right, they at last arrive at the desired result! This instrument will insensibly impress upon the minds of those who use it, that in every triangle all the parts bear a rigid and definite relation to each other, and that having certain things given, certain others can thence invariably be found; and that any three things that can be brought to the shape of a triangle, become, thereby, objects of simple computation, whether they are distance, difference of latitude and departure, or the mainmast, a main shroud, and the horizontal line joining that mast and shroud along the deck."

Besides, as the results produced by this instrument must necessarily be perfectly correct, it furnishes an excellent means of verifying computations, and must, on this account alone, be of great use to the young and inexperienced.

We earnestly hope that Mr. Crow will not go without the reward which he deserves for this valuable contribution to nautical practice. He acknowledges to have received "liberal support and approval from the Hon. East India Company;" but speaks of the introduction of the instrument into the Royal Navy, as "a hope yet to be indulged." How is this? To whom can the improvement of navigation be of more importance than to the government of this, the first maritime nation in the world? Thousands and tens of thousands have been lavished by it on inventions, (Rotch's fid, for example) of not a tenth part the importance. [*Mech. Mag.*

¶ *Selections from Professor Babbage's Work "on the Economy of Machinery and Manufactures."*

Lace made by Caterpillars.

A most extraordinary species of manufacture, which is, in a slight degree, connected with copying, has been contrived by an officer of engineers, residing at Munich. It consists of lace, and veils, with open patterns in them, made entirely by caterpillars. The following is the mode of proceeding adopted:—

Having made a paste of the leaves of the plant, on which the species of caterpillar he employs feeds, he spreads it thinly across a stone, or other flat substance, of the required size. He then with a camel's hair pencil, dipped in olive oil, draws the pattern he wishes the insects to leave open. This stone is then placed in an inclined position, and a considerable number of the caterpillars are placed at the bottom. A peculiar species is chosen, which spins a strong web; and the animals commence at the bottom, eating and spinning their way up to the top, carefully avoiding every part touched by the oil, but devouring every other part of the paste. The extreme lightness of these veils, combined with some strength, is truly surprising. One of them measuring twenty-six and a half inches by seventeen inches, weighed only 1.51 grains, a degree of lightness which will appear more strongly by contrast with other fabrics. One square yard of the substance of which these veils are made weighs four grains and one-third, whilst one square yard of silk gauze weighs one hundred and thirty-seven grains, and one square yard of the finest patent net weighs two hundred and sixty-two grains and a half.

Convenient method of Gauging.

The time and labour consumed in gauging casks partly filled, has led to an improvement which, by the simplest means, obviates a considerable inconvenience, and enables any person to read off, on a scale, the number of gallons contained in any vessel as readily as he does the degrees of heat indicated by his thermometer. A small stopcock is inserted near the bottom of the cask, which it connects with a glass tube of narrow bore fixed to a scale on the side of the cask, and rising a little above its top. The plug of the cock must be turned into three positions: in the first it cuts off all communication with the cask: in the second, it opens a communication between the cask and the glass tube: and in the third, it cuts off the connexion between the cask and the tube, and opens a communication between the tube and any vessel held beneath the cock to receive its contents. The scale of the tube is graduated by opening the communication between the cask and the tube, and pouring into the cask a gallon of water. A line is then drawn on the scale opposite the place in the tube to which the water rises. The operation is repeated, and at each successive gallon a new line is drawn. Thus the scale being formed by actual measurement,* both the proprietor and the excise officer see, on inspection, the contents of each cask, and the tedious process of gauging is altogether dispensed with. Other advantages accrue from this simple contrivance in the great economy of time which it introduces in making mixtures of different spirits, in taking stock, and in receiving spirits from the distiller.

Diamonds for Cutting Glass.

The art of using the diamond for cutting glass has undergone, within a few years, a very important improvement. A glazier's apprentice, when using a diamond set in a conical ferule, as was always the practice about twenty years ago, found great difficulty in acquiring the art of using it with certainty, and at the end of a seven years apprenticeship, many were found but indifferently skilled in its employment. This arose from the difficulty of finding the precise angle at which the diamond cuts, and of guiding it along the glass at the proper inclination when that angle is found. Almost the whole of the time consumed, and of the glass destroyed in acquiring the art of cutting glass, may now be saved by the use of an improved tool. The gem is set in a small piece of squared brass, with its edge nearly parallel to one side of the square. A person skilled in its use now files away one side of the brass, until, by trial, he finds that the diamond will make a clean cut, when guided by keeping this edge pressed against a ruler. The diamond and its mounting are now attached to a stick similar to a pencil, by means of a swivel, allowing a small angular motion. Thus the merest tyro at once applies the cutting edge at the proper angle, by pressing the side of the brass against a ruler; and even though the part he holds in his hand should deviate a little from the required angle, it communicates no irregularity to the position of the diamond, which rarely fails to do its office when thus employed.

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* This contrivance is due to Mr. Henneky, of High Holborn, in whose establishment it is in constant employment.

The relative hardness of the diamond, in different directions, is a singular fact. An experienced workman, on whose judgment I can rely, informed me that he had seen a diamond ground with diamond powder on a cast iron mill for three hours without its being at all worn, but that changing its direction with reference to the grinding surface, the same edge was ground down.

Example of the method of Calculating by Machinery.

As the possibility of performing arithmetical calculations by machinery may appear to non-mathematical readers to be rather too large a postulate, and as it is connected with the subject of the *division of labour*, I shall here endeavour in a few lines to give some slight perception of the manner in which this can be done, and thus remove a small portion of the veil which covers that apparent mystery.

That nearly all tables of numbers which follow any law, however complicated, may be formed, to a greater or less extent, solely by the proper arrangement of the successive addition and subtraction of numbers befitting each table, is a general principle, which can be demonstrated to those only who are well acquainted with mathematics; but the mind, even of the reader who is slightly acquainted with that science, will readily conceive that it is not impossible, by attending to the following examples. Let us consider the subjoined table. This table is the beginning of one in very extensive use, which has been printed and reprinted very frequently in many countries, and is called *a table of square numbers*.

Terms of the table.	A table of squares.	B first difference.	C second difference.
1	1		
		3	
2	4		2
		5	
3	9		2
		7	
4	16		2
		9	
5	25		2
		11	
6	36		
		13	
7	49		

Any number in the table, column A, may be obtained by multiplying the number which expresses the distance of that term from the commencement of the table by itself; thus 25 is the 5th term from the beginning of the table, and five multiplied by itself, or by five, is equal to 25. Let us now subtract each term of this table from the next succeeding term, and place the results in another column, (B,) which may be called first difference column. If we again subtract each term from this first difference from the succeeding term, we find the result is always the number two, (column C;) and that the same number will always recur in that column, which may be called the second difference, will appear to any person who takes the trouble to carry on the table a few terms further. Now when once this is admitted as a known fact, it is quite clear that, provided the first term (1) of the table, the first term (3) of the first differences, and the first term (2) of the second or constant difference, are originally given, we can contrive the table of square numbers to any extent, merely by simple addition: for the series of first differences may be formed by repeatedly adding the constant difference 2 to (3) the first number, column B, and we then necessarily have the series of odd numbers, 3, 5, 7, &c.; and again, by successively adding each of these to the first number (1) of the table, we produce the square numbers.

Having thus, I hope, thrown some light upon the theoretical part of the question, I shall endeavour to show that the mechanical execution of such an engine as would produce this series of numbers, is not so far removed from that of ordinary machinery as might be conceived. Let the reader imagine three clocks, placed on a table side by side, each having only one hand, and each having a thousand divisions instead of twelve hours marked on the face, and every time a string is pulled let them strike on a bell the number of divisions to which the hands point. Let him further suppose that two of the clocks, for the sake of distinction called B and C, have some mechanism by which the clock C advances the hand of the clock B one division for each stroke it makes upon its own bell; and let the clock B, by a similar contrivance, advance the hand of the clock A one division for each stroke it makes upon its own bell. With such an arrangement, having set the clock A to the division I, that of B to III, and that of C to II, let the reader imagine the repeating parts of the clocks to be set in motion continually in the following order: viz. pull the string of clock A; pull the string of clock B; pull the string of clock C.

Repetition of process.	Movements.	Clock A. — Hand set to I.	Clock B. — Hand set to III.	Clock C. — Hand set to II.
		Table.	1st. diff.	2nd. diff.
1	Pull A.	A strikes - 1		
	— B.	The hand is advanced (by B) 3 divisions.	B strikes - 3	
	— C.	- - -	The hand is advanced (by C) 2 divisions.	C strikes 2
2	Pull A.	A strikes - 4		
	— B.	The hand is advanced (by B) 5 divisions.	B strikes - 5	
	— C.	- - -	The hand is advanced (by C) 2 divisions.	C strikes 2
3	Pull A.	A strikes - 9		
	— B.	The hand is advanced (by B) 7 divisions.	B strikes - 7	
	— C.	- - -	The hand is advanced (by C) 2 divisions.	C strikes 2
4	Pull A.	A strikes - 16		
	— B.	The hand is advanced (by B) 9 divisions.	B strikes - 9	
	— C.	- - -	The hand is advanced (by C) 2 divisions.	C strikes 2
5	Pull A.	A strikes - 25		
	— B.	The hand is advanced (by B) 11 divisions.	B strikes - 11	
	— C.	- - -	The hand is advanced (by C) 2 divisions.	C strikes 2
6	Pull A.	A strikes - 36		
	— B.	The hand is advanced (by B) 13 divisions.	B strikes - 13	
	— C.	- - -	The hand is advanced (by C) 2 divisions.	C strikes 2

If now only those divisions struck and pointed at by the clock C be attended to and written down, it will be found that they produce the series of the squares of the natural numbers.

Meteorological Observations for September, 1832.

Moon.	Days	Therm.		Barometer.		Dew point	Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise	2 P.M.	Sun rise.	2 P.M.		Direction.	Force.		
				Inches	Inches.				inches.	
	1	56°	70°	29.81	29.84	49	NW.	Moderate.		Clear day.
☽	2	53	71	30.00	30.00	48	W.	do.		Clear day.
	3	58	70	.00	.00	60	S.	do.		Light clouds—rain.
	4	51	69	29.80	29.70	69	S. SW.	do.	.70	Rain—cloudy.
	5	59	67	.64	.70	52	NW. W.	Breeze.		Flying clouds—clear.
	6	48	68	.84	.84	52	W.	do.		Clear day.
	7	56	72	.80	.71	60	SW.	do.		Cloudy—clear.
	8	54	72	.90	.95	51	SW.	do.		Clear—flying clouds.
	9	50	71	.94	30.5	49	W.	do.		Clear day.
🌝	10	51	72	30.20	.20	57	N. S.	do.		Clear—flying clouds.
	11	59	89	.00	29.90	67	SE. S.	Blustering.	.25	Cloudy—rain—rain in n't.
	12	58	66	29.80	.81	54	W.	do.	.15	Clear day.
	13	46	61	30.10	30.10	41	W.	Moderate.		Clear day.
	14	44	89	.10	.10	49	W.	do.		Clear—light clouds.
	15	54	72	.10	.04	58	W.	do.		Cloudy—clear.
	16	60	81	.00	.00	70	W.	do.		Clear day—slight thunder [shower.
☾	17	64	79	.00	.00	66	N.	do.	.1	Clear day.
	18	59	78	.20	.20	63	SW.	Calm.		Clear day.
	19	58	69	.14	.00	68	SW.	Breeze.		Clear day.
	20	64	77	29.93	29.93	61	SE.	do.		Fog—cloudy.
	21	64	74	.70	.70	69	E.	do.		Cloudy day.
	22	66	69	.70	.70	56	S.	do.		Drizzle—cloudy.
	23	52	62	.80	30.00	48	NW.	do.	.1	Clear—cloudy.
⊗	24	48	52	30.00	29.90	55	SE.	do.		Cloudy day—rain in n't.
	25	54	63	29.70	.80	45	W.	Blustering.	.7	Cloudy—flying clouds.
	26	43	61	30.00	30.00	47	W.	Moderate.		Clear day.
	27	51	70	29.96	29.90	59	W.	do.		Cloudy—flying clouds.
	28	62	72	.98	.96	61	SE	do.		Cloudy—flying clouds.
	29	62	69	.83	.70	61	NNE. N.	do.		Cloudy day.
	30	56	68	.70	.70	61	SW.	do.		Cloudy day.
	Mean	55.33	70.33	29.92	29.91	56.9			1.19	

	Thermometer.	Barometer.
Maximum height during the month,	89. on 11th and 14th.	30.20 on 10th and 18th.
Minimum . do. . .	44. on 14th.	29.64 on 5th.
Mean do. . .	63.03 . .	29.92

JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

DEVOTED TO THE

MECHANIC ARTS, MANUFACTURES, GENERAL SCIENCE,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

DECEMBER, 1832.

Remarks upon the recent patent for a Shot, and Shell, with Spiral Flanches.

TO THE COMMITTEE ON PUBLICATIONS.

Gentlemen,—The October number of your Journal contains an account of the specification of a patent, granted to William B. Pier and Andrew Mark, of Detroit, Michigan Territory, "for an improvement in the science of gunnery, which may be used as a substitute for the ordinary bomb shell, or howitzer, &c." It can, I think, be shown that the patentees have been anticipated in the principles of their invention, and that various defects to which, in practice, their plan would be liable, have been avoided in the prior invention to which I allude. If these facts are so, while one must regret the expenditure of ingenuity, of time, and, perhaps, of money, already encountered by the patentees, it can but be a service to them to prevent their more serious loss of each, which, probably, will be consequent on endeavours to bring the scheme into use, under the sanction of a patent right which cannot be sustained.

It is well known that a canon ball, whatever pains may have been taken in its casting, is, as a general rule, not of uniform density throughout; as a consequence of this, if a ball were supposed to leave the muzzle of a gun without having acquired a rotary motion, the forces which act upon it in its flight would produce such a motion. This is especially the case with hollow shot, or shells, the construction and loading of which effectually prevent the coinciding of the centre of gravity with the centre of the shell. These projectiles are placed in the mortar, from which they are thrown, with the fusee towards the muzzle; immediately on leaving the muzzle the fusee is seen turned in the opposite direction, and a rotation which may be very distinctly traced in night firing, is commenced about a line inclined to the axis of the mortar. This rotation produces not only a deviation in the shell, or shot, in the vertical plane passing through the axis of the piece, but also from that plane. In small arms, the defects just stated are remedied by grooving the barrel, as in the rifle. By these grooves a tendency to rotation is produced in the ball while passing through the barrel; a rotation which the action of the air, upon the grooves produced in the ball, tends to keep up. The axis of rotation coincides with that of the barrel, and there is no tendency produced to vary the curve in the plane of projection, nor to depart from that plane; under these circumstances the aim becomes certain.

We may suppose the patentees to have reasoned upon some such principles in their endeavour to give to larger projectiles the accuracy of flight of the rifle ball. They propose to effect this by using spiral flanches upon their shells, or shot, by which to give a rotation similar to that produced in the rifle. The form of the shot, independently of the flanches, "is that of an elongated egg with the small end truncated, or cut square off." "The large, or forward end, which nearly fits the calibre of the piece, is a solid hemisphere of metal, the weight of which will insure its keeping the proper direction when fired from the piece." This form is admirably calculated to defeat the object to be accomplished by the flanches, and would seem to show that I have attributed too much practical knowledge of the motion of projectiles to the patentees. It is certain that the solid hemisphere in front, instead of increasing the accuracy of the fire, would, by a tendency to descend, at the instant of leaving the piece, begin a rotation about an axis perpendicular to the axis of the piece, the effect of which on the rotation to be produced by the flanches, parallel to that axis, is obvious.

The shell now patented is "to be made to explode by means of percussion powder. For this purpose a hole is to be drilled through the larger end, or bulb, of the shell, in the direction of the axis." "An iron or steel bolt surrounded by leather, or other elastic substance, is put over the percussion powder, and extends out from the front of the shell; its exterior end widens out like a nail or bolt head. This striking against any hard substance, occasions the contents of the shell to explode."

I shall show that the patentees have been anticipated in their design of using spiral flanches, and, also, in their project for making a shell to explode when it strikes; unless, indeed, in relation to the latter point, the use of a conical plug of iron, covered with leather, instead of a wooden cylinder, be, *technically*, of importance. With regard to the form of the shell, if my remarks be correct, it is very defective.

To prove the positions taken, I shall give extracts from a "Description of a Percussion shell,* to be fired horizontally from a common gun. By Lieutenant Colonel Miller, late of the Rifle Brigade," &c. This paper was published in 1827, and purports to have been read before the Royal Society of London, on the 16th and 23d of November, 1826.

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* Transactions of the Royal Society of London, Part I, 1827.

After giving an outline of the theory of the rifle, Col. Miller details experiments, by which he proved that a rotary motion about the longer axis of a projectile might be given to it by grooving the projectile itself. The cylindrical form was first tried, and subsequently an attempt made to terminate the cylinder by a hemisphere, which failed. The conclusions drawn from the experiments are thus stated.

"Having, as I conceived, conclusively ascertained by experiment, that the spiral motion might be communicated to a grooved cylindrical ball fired from a plain barrel, it occurred to me that by the help of this principle, shells might be so constructed as to explode by percussion. The plan I have adopted for this purpose will be easily understood by an examination of the annexed figure.* A round peg is placed in the apex of the cone, working in a cylinder, and a pellet of percussion powder is placed under the peg, and over the vent which communicates with the cavity of the shell. By this means, as soon as the point of the peg strikes against any hard substance, it slides in, and ignites the percussion powder, which instantly communicates with the bursting charge."

An account of experiments with these shells in different situations, with various charges, and fired at different objects, is next given: two series of these experiments were made in 1823, and a third in 1826. From these the following conclusions are drawn.

"So far as range and efficiency are concerned, the experiments have perhaps been as successful as could have been expected, in so novel an invention. With respect to accuracy of fire, I am fully sensible that much still remains to be done; and to those who ask why this most important object was not more completely attained before the discovery was submitted to the public, I beg leave to answer, that no invention in gunnery, so far as I am aware, either in former or more recent times, has ever been brought to perfection without the help of long continued and laborious experiments, which from their nature are so expensive that they cannot be expected to be prosecuted at the cost of any individual. In the present instance, only one hundred and four shells have been fired altogether, eighty-five of which were filled with powder, and, out of these, thirty-nine exploded upon striking the objects fired at. In the experiments made at Woolwich, on the Pheasant, sloop of war, in the river, which are certainly the most important that have yet been made, only eleven succeeded out of thirty-one; no great number certainly, but at the same time enough to have destroyed the vessel had they been heavy metal. The fire at present is sufficiently accurate for the range at which naval actions are generally fought, but the object in view is to make them available to the full extent of their range, and I shall accordingly point out the means by which I conceive this object may be very much facilitated. Considerable improvement may, I think, yet be made in the mode of casting them; for although the gentlemen of the Carron Company have bestowed great pains on those that were cast by them, it seldom happens, in matters of this kind, that the most simple process is discovered in the first instance. They may also be turned in a lathe by means of machinery, which their shape will allow them to be with great facility, and thus rendered perfectly cylindrical, and of the same size. In the course of the experiments that have been made, the shell has also been greatly improved by an addition to the length originally given to it. This might, a priori, have been expected, as its weight is increased without increasing the resistance of the air; and by this alteration its range is found to be increased also. The accuracy of fire is also found to be greater, as the angle of departure is diminished. Hence, greater accuracy of fire may be expected from heavy guns than from light ones, the sides of the shells in the former being much longer than in the latter, while the windage in both is equal. The following construction of a shell for a nine pounder, I consider as the best, so far as the experiments made will allow me to determine. In these proportions the length of the sides is increased half an inch beyond that of any yet used, and the twist is reduced from fifty-five to seventy-two inches.

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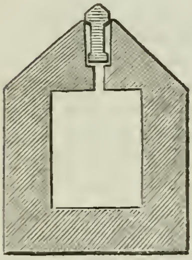
* See the cut on p. 364.



Length, - -	6.24	inches.
Diameter, - -	4.16	,,
Length of sides, -	4.16	,,
Height of cone, - -	2.08	,,
Depth of grooves, -	0.20	,,
Width of ditto round the circumference, - -	0.80	,,
Length of peg, -	1.40	,,
Diameter of ditto, - -	0.40	,,
Diameter of vent, -	0.15	,,
Thickness of sides, -	0.85	,,
Thickness of bottom, -	0.74	,,
Diameter of chamber, -	2.46	,,
Height of ditto, -	3.42	,,
Windage, - -	0.04	,,

The necessity of *perfectly* balancing the shell is insisted on, and a method of effecting it is given in the paragraph which follows.

"In all the experiments already made, it has been observed that the line of fire is generally good, but that the shells which have missed the object, went almost invariably either too high or too low, which is exactly the result we might, from theory, expect, when their ends are not perfectly balanced. The method of proving whether their ends be exactly balanced, is by floating them in mercury, their specific gravity when filled being something less than half that of mercury. When properly balanced, they float horizontally, and the balance is not perfect until that is effected."

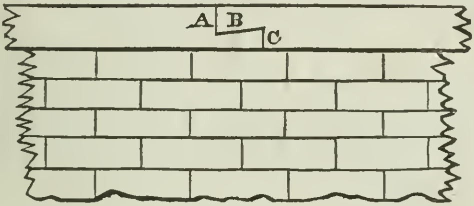
The successful experiments of the Messrs. Stevens, of New York, with shells exploding on striking an object, were prior to those of Col. Miller; the details of them, and the method of accomplishing their object, were, I believe, never made public. The form of the shell differed from that of Col. Miller, as well as that of the recent patentees.

B.

Expansion and Contraction of Coping Stones.

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Sir,—Observing in your number for July, 1832, that the contraction and expansion of coping stones had been attended with unpleasant consequences in the opening of the joints, I take the liberty of handing you the annexed sketch for the joints of coping stones, which has been found sufficient to protect the wall from the drip at the joints. If the joints are made as in the sketch the water can never injure the wall through them.



It is necessary that the water should pass through the joints A, B, C, to get to the wall, but this is effectually prevented by the inclination of the joint B. It is more expensive than the common method, but needs no cement, and the ordinary contractions and expansions can never injure it.

I am, sir, respectfully,

Your obedient servant,

W. T.

FRANKLIN INSTITUTE.

Continuation of the Report of the Committee of the Franklin Institute of Pennsylvania, appointed May, 1829, *to ascertain, by experiment, the value of Water as a moving Power.*

[Continued from p. 302.]

TABLE 3.—PART I.

WHEEL No. IV.—30 *Oblique buckets. Close breast. Water let on at upper centre of wheel.*

No. of Exper't.	Head of water above.			Width of Aperture	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.															
	Feet.	Feet.	Feet.	In.	Pds.	Pds.	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
1	0.25	0.50	1.00	1.00	57	23.07	80.07	40.0	38½	5.64	625	6.50	40625	32028	.788			
2					71	23.20	94.20		42	5.16	730		47450	37680	.794			
3					85	23.33	108.33		47½	4.57	825		53625	43332	.808	.808	4.57	
4					99	23.46	122.46		57½	3.77	955		62075	48984	.789			
5				1.25	71	23.20	94.20		37½	5.77	750		48750	37680	.773			
6					85	23.33	108.33		47½	4.57	855		55575	43332	.779			
7					99	23.46	122 46		50	4.34	965		62725	48984	.781	.781	4.34	
8					113	23.59	136.59		55½	3.90	1085		70525	54636	.775			
9				1.50	85	23.33	108.33		38½	5.64	880		57200	43332	.757			
10					99	23.46	122.46		41½	5.22	990		64350	48984	.761			
11					113	23.59	136.59		48½	4.47	1085		70525	54636	.775			
12					127	23.72	150.72		54	4.01	1190		77350	60288	.779			
13					138	23.82	161.82		54½	3.97	1240		80600	64728	.803	.803	3.97	
14					146	23.90	169.90		59	3.67	1315		85475	67960	.795			
15				1.75	132	23.77	155.77		47½	4.57	1295		84175	62308	.740			
16					146	23.90	169.90		49½	4.38	1385		90025	67960	.755			
17					160	24.03	184.03		55½	3.90	1490		96850	73612	.760			
18					174	24.16	198.16		57	3.81	1580		102700	79264	.772	.772	3.81	
19					202	24.42	226.42		61½	3.52	1830		118950	90568	.762			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

Table 3.—Part II

Wheel No. IV.—30 *Oblique buckets. Close breast. Water let on at upper centre of wheel.*

No. of Exper't.	Head of water above.			Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	W't of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.															
	Feet.	Feet.	Feet.	In.	Pds.	Pds.	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
20	0.25	0.50	1.00	2.00	132	23.77	155.77	40.0	44	4.90	1355	6.50	88075	62308	.707			
21					160	24.03	184.03		49½	4.38	1560		101400	73612	.726			
22					174	24.16	198.16		54	4.01	1660		107900	79264	.734			
23					202	24.42	226.42		59½	3.64	1870		121550	90568	.745	.745	3.64	
24	0.75	1.00	1.50	0.75	113	23.59	136.59	40.0	33½	6.47	1050	7.00	73500	54636	.743			
25					132	23.77	155.77		37	5.86	1195		83650	62308	.745			
26					146	23.90	169.90		41½	5.22	1305		91350	67960	.744			
27					160	24.03	184.03		43	5.03	1405		98350	73612	.748			
28					174	24.16	198.16		46½	4.67	1505		105350	79264	.753			
29					188	24.29	212.29		66½	3.25	1575		110250	84916	.770	.770	3.25	
30					216	24.55	240.55		79½	2.73	1825		127750	96220	.754			
31					230	24.68	254.68		59	3.67	1930		135100	101872	.754			
32					235	24.73	259.73		60½	3.58	2000		140000	103892	.742			
33				1.00	132	23.77	155.77		32½	6.67	1205		84350	62308	.739			
34					216	24.55	240.55		73	2.97	1770		123900	96220	.777	.777	2.97	
35					230	24.68	255.68		62½	3.47	1885		131950	101872	.772			
36					249	24.86	273.86		71	3.06	2070		144900	109544	.756			
37					263	24.99	287.99		58	3.74	2170		151900	115196	.758			
38					277	25.12	302.12		62	3.50	2325		162750	120848	.742			
39					291	25.25	316.25		63½	3.41	2445		171150	126500	.739			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE 3.—PART III.

WHEEL No. IV.—30 *Oblique buckets. Close Breast. Water let on at upper centre of wheel.*

No. of Exper't.	Head of water above.			Width of Aperture	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.															
	Feet.	Feet.	Feet.	In.	Pds.	Pounds.	Pounds.	Feet.	Seds.	Feet.	Pds.	Feet.						
40	0.75	1.00	1.50	1.25	305	25.38	330.38	40.0	56½	3.83	2500	7.00	175000	132152	.755			
41					319	25.51	344.51		60	3.61	2580		180600	137804	.763	.763	3.61	
42					333	25.64	358.64		61	3.55	2715		190050	143456	.755			
43				1.75	352	25.82	377.82		59½	3.64	3055		213850	151128	.707			
44					366	25.95	391.95		61	3.55	3135		219450	156780	.715	.715	3.55	
45					380	26.08	406.08		63	3.44	3250		227500	162432	.714			
46					394	26.21	420.21		64½	3.36	3375		236250	168084	.712			
47					408	26.34	434.34		68	3.19	3530		247100	173736	.703			
48	1.75	2.00	2.50	0.75	291	25.25	316.25	40.0	59	3.67	2250	8.00	180000	126500	.703	.703	3.67	
49					319	25.51	344.51		64½	3.36	2500		200000	137804	.689			
50					333	25.64	358.64		66	3.28	2600		208000	143456	.690			
51				1.00	338	25.69	363.69		48½	4.47	2625		210000	145476	.693			
52					352	25.82	377.82		46½	4.67	2700		216000	151128	.700	.700	4.67	
53					366	25.95	391.95		50½	4.32	2805		224400	156780	.699			
54					380	26.08	406.08		59	3.67	2920		233600	162432	.695			
55					394	26.21	420.21		63½	3.41	3040		243200	168084	.691			
56					408	26.34	434.34		69½	3.12	3200		256000	173736	.679			
57	2.75	3.00	3.50	1.50	319	25.51	344.51	40.0	38	5.71	2380	9.00	214200	137804	.643			
58					333	25.64	358.64		40	5.42	2475		222750	143456	.644	.644	5.42	
59					352	25.82	377.82		42½	5.10	2630		236700	151128	.638			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE 4.

WHEEL No. IV.—30 *Curved buckets. Water let on at upper centre of wheel.*

No. of Exper't.	Head of water above.			Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.															
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
1	0.25	0.50	1.00	0.50	113	23.59	136.59	40.0	37½	5.78	1080	6.50	75600	54636	.723			
2					127	23.72	150.72		40½	5.35	1185		82950	60288	.727	.727	5.35	
3					146	23.90	169.90		47	4.61	1360		95200	67960	.714			
4				1.00	85	23.33	108.33		44	4.90	850		55250	43332	.784			
5					99	23.46	122.46		52½	4.13	940		61100	48984	.802	.802	4.13	
6					127	23.72	150.72		63	3.44	1180		76700	60288	.786			
7					146	23.90	169.90		73½	2.95	1355		88075	67960	.772			
8				1.25	113	23.59	136.59		49	4.43	1105		71825	54636	.761			
9					132	23.77	155.77		57½	3.77	1255		81575	62308	.764			
10					146	23.90	169.90		60	3.61	1360		83400	67960	.769	.769	3.61	
11	1.75	2.00	2.50	0.25	132	23.77	155.77	40.0	52	4.17	1170	8.00	93600	62308	.666			
12					146	23.90	169.90		55½	3.90	1270		101600	67960	.669			
13					160	24.03	184.03		55½	3.90	1360		108800	73612	.677	.677	3.90	
14					174	24.16	198.16		50½	4.29	1475		118000	79264	.672			
15					188	24.29	212.29		65	3.34	1625		130000	84916	.653			
16				0.50	160	24.03	184.03		37½	5.78	1460		116800	73612	.630			
17					174	24.16	198.16		52	4.17	1460		116800	79261	.679	.679	4.17	
18					188	24.29	212.29		43	5.03	1620		129600	84916	.655			
19					216	24.55	240.55		47½	4.57	1905		152400	96220	.631			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE 5.—PART I.

WHEEL No. IV.—30 *Curved buckets of fig. 5, Plate VIII. Water let on at upper centre of wheel.*

No. of Exper't.	Head of water above.			Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.															
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
1	0.42		1.17	2.25	146	23.90	169.90	40.0	47½	4.57	1380	6.67	92046	67960	.738			
2					160	24.03	184.03		52	4.17	1455		97048	73612	.758			
3					174	24.16	198.16		53	4.09	1570		104719	79264	.757			
4					188	24.29	212.29		57½	3.76	1675		111722	84916	.760			
5					202	24.42	226.42		63½	3.42	1800		120060	90568	.755			
6					216	24.55	240.55		64½	3.36	1820		121394	96220	.793			
7					230	24.68	254.68		68	3.19	2030		135401	101872	.752			
8					235	24.73	259.73		78	2.78	2100		140070	103892	.742			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE 5.—PART II.

WHEEL NO. IV.—30 *Curved buckets of fig. 5, Plate VIII. Water let on at upper centre of wheel.*

No. of Exper't.	Head of water above.			Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.															
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
1	2.75		0.84		85	23.33	108.33	40.0	47	4.63	1480	6.67	98716	43332	.439			Water run over the gate 2¾ inches deep, when drawn entirely open with 6 ft. 8 inches head and fall—wheel removed one inch from breast—tail-way one-eighth in. from bottom of wheel.
2					113	23.59	136.59		55	3.93	1515		101050	54636	.541			
3					127	23.72	150.72		58	3.74	1645		109722	60288	.550			
4					146	23.90	169.90		65	3.34	1790		119393	67960	.569			
5					160	24.03	184.03		64	3.39	1870		124729	73612	.590			
6					174	24.16	198.16		68	3.19	1975		131399	79264	.603			
7					188	24.29	212.29		71	3.06	2100		140070	84916	.606			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

[TO BE CONTINUED.]

Quarterly Meeting.

The thirty-fifth quarterly meeting of the Institute was held at their Hall, October 18, 1832.

Alexander Ferguson was appointed Chairman, and

Frederick Fraley, Recording Secretary, P. T.

The minutes of the thirty-third quarterly meeting were read and approved.

The thirty-fifth quarterly report of the Board of Managers was read and accepted, when, on motion, it was referred to the committee on Publications, with instruction to publish it in the Journal of the Institute.

The quarterly report of the Treasurer was read and accepted.

On motion, the reading of the thirty-fourth quarterly report of the Board of Managers was called for, as a quorum sufficient to transact business did not attend on the evening appointed for that meeting, and the report was not read; after reading the report it was accepted and referred to the committee on publications for insertion in the Journal of the Institute.

Professor A. D. Bache made some remarks on the art of medal ruling, in which he claimed the credit of the present useful application of it for America: he submitted specimens of the work executed by Asa Spencer, of Philadelphia, to the meeting, and the first published specimen of the execution of Mr. Bate, of London, contained in Prof. Babbage's work on the economy of manufactures and machinery. He drew a comparison between the works, favourable to that of Mr. Spencer, remarking that the distortion produced by the method used by this artist, although it would become perceptible in works of very high relief, was scarcely so in medal ruling, and did not turn the balance in favour of the work of Mr. Bate of which the specimen was exhibited.

A copy of the diploma of membership of the Institute, just finished, was laid on the table for the inspection of the members.

Extract from the minutes.

Alexr. Ferguson, *Chairman.*

Frederick Fraley, *Rec. Sec. P. T.*

Thirty-fourth Quarterly Report of the Board of Managers of the Franklin Institute.

Hall of the Franklin Institute, July 12, 1832.

The Board of Managers respectfully present to the Institute their report for the second quarter of the present year.

Preparations are making for the exhibition of American manufactures to be held in October next, and for the reopening of the schools and commencement of the lectures.

It is hoped that in addition to the usual courses, an efficient series of lectures on machines may be introduced. The difficulty in the way of this important course lies in the models and machinery necessary for illustration. The Institute have not the funds to supply these. It is hoped that the zeal of the individual members may be relied upon to promote by the gift or deposit of suitable models and machinery, this useful and interesting object.

The Board of Managers have given the fullest consideration to the subject referred to them at the last Quarterly meeting, viz. the better accommodation of the lecturers of the Institute.

They find that an extension of the present accommodation could be obtained only in one of two ways; either by depriving the members of the privilege which they now enjoy in the reading room and library, or by taking from the institution revenues which are necessary to the payment of the interest on, and the gradual extinction of, the debt for which it stands pledged.

While, therefore, the Board consider that the better accommodation of the lecturers, by appropriating separate rooms to the lecturer on chemistry, and to the lecturers on Natural Philosophy and Mechanics, is very desirable, they cannot see in the present state of the institution circumstances which would warrant the undertaking.

Having twice in the course of this report referred to the limited nature of the funds of the Institute, the Board of Managers would take this occasion to submit a few remarks, in relation to the funds by which inquiries, connected with the objects of the Institute, have been carried on.

The expenses of the important experiments on water power were defrayed by individual contributions, and not by the Institute.

The later researches under the direction of the committee on explosions, were commenced at the request of the Secretary of the Treasury of the United States, and are making at the expense of the Department.

The sum appropriated to the committee on statistics has not been considerable in amount, and this amount was granted under the impression that a measure originating with the members of the Institute, at one of their quarterly meetings, must fail, unless the funds asked by the committee were provided.

The Journal of the Institute is now able to support itself, and will, probably, before a great while, redeem the loan made on its assumption by the Institute.

Thus it appears that important objects have been accomplished, and are accomplishing, without drawing from the treasury of the Institute the sums required to extinguish the debt for which it is pledged, and which, remaining unpaid, must always trammel the operations of the institution.

The Board announce with regret the resignation of Franklin Bache, M. D. Professor of Chemistry in the Institute. The efficient services of this gentleman have secured to him the respect and esteem of those with whom he has now for six years been connected.

Isaac B. Garrigues, *Chairman.*

William Hamilton, *Actuary.*

Thirty-fifth Quarterly Report of the Board of Managers of the Franklin Institute.

Hall of the Franklin Institute, October 11, 1832.

The Board of Managers submit to the Institute their report for the third quarter of the present year.

Since the last report several changes have taken place in the affairs of the institution, which are of interest.

The committee on Premiums and Exhibitions, by the advice of the committee of arrangement, determined to postpone the usual exhibition of domestic manufactures, in relation to the time of holding which they had received authority from the managers to decide. The gloomy state of a sister city, the apprehension which our own community, in conjunction with all others, felt in anticipation of the extensive prevalence of a wide spreading epidemic, rendered prudent the course adopted by the committee.

The resignation of our Professor of Chemistry, which the Board of Managers had the regret to announce in their last report, was followed by the appointment of John K. Mitchell, M. D. as his successor. The talents and attainments of this gentleman are well known to the members of the institute. The zeal with which he has entered upon the preparations for the ensuing course, give an earnest of his exertions to carry it to a successful completion.

On the last day of August, the rooms on the third floor of the hall were given up by Professor Johnson. The schools having at that time made their arrangements for the year, the rooms could not at once be rented. The Institute, on this account, though temporary sufferers, will ultimately be benefitted, since the delay has given time for a division of the third floor into six rooms. By this division the Drawing school and the English school will have suitable accommodations, a room for Models and Machinery be provided, and a rent be obtained.

The lectures for the ensuing season will commence on the last Monday in October, (October 25th,) the introductory lectures will be given on Monday, Wednesday, and Saturday, of the first week, after which the regular lectures of the course will commence. The chemical lectures will be given every Monday evening, those on natural philosophy every Wednesday, and those on machines every alternate Saturday evening. It is expected that volunteer lectures will occupy the alternate Saturday evenings.

The Board would again call the attention of the members to the promotion, by the gift or deposit of suitable models and machinery, or by donations in money, of the course on machines. Such a course as cannot fail to be useful as well as interesting has been sketched out by the lecturer on that branch, Franklin Peale, Esq. the completion of which must, in a great degree, depend upon the liberality of the members of the Institute. To those who have already come forward with subscriptions the Board return their acknowledgments.

The better accommodation of the Drawing school, to which the

Board has already alluded, is calculated to increase the popularity of that important school. The English evening school of the Institute, will be opened on Monday evening, October 15th, in the eastern room on the third floor of the hall. This school will be, as last year, under the charge of Seth Smith, Esq. It is hoped that the patronage of the members of the Institute, will be freely extended to this school; the qualifications of the teacher, and the highly creditable manner in which the system of his school was carried forward during the last year entitle him to their entire support.

The inquiries in practical science undertaken by the Institute are continued. The report of the committee on water wheels has, as far as the experimental part is concerned, been nearly completed, and that of the committee on the explosions of steam boilers is in progress. The branch of the investigations of the latter committee connected with the strength of materials, is steadily progressing. Many of the members have been present at a portion of the experiments, and have perceived the extent of labour which has been undertaken: time and great perseverance on the part of the committee are required to accomplish all the objects within the scope of the inquiries.

The diploma of membership has been prepared, and the insertion of the names of members is all that is wanting to make it ready for delivery.

Respectfully submitted.

Isaac B. Garrigues, *Chairman.*

William Hamilton, *Actuary.*

Analysis of the Report, &c. on Steam Carriages.

Report on Steam Carriages by a Committee of the House of Commons of Great Britain. With the minutes of Evidence, and Appendix. Reprinted by order of the House of Representatives of the United States. (1832.)

The next witness examined was Richard Trevithick, the individual who, with Evans, first brought the high pressure engine into use; the first to attempt locomotion *on rail-roads* by the mere adhesion of the wheels to the rails. Trevithick informs us that he has for many years resided out of England, and indeed his testimony fully shows this, his ideas in relation to the high pressure engine being those of twenty years since: he gravely contends that every time the elasticity of steam is doubled a saving of seventy-five per cent. in fuel is made! he is full of a new project of a safe and most economical boiler, which he describes, and which he supposes will replace every other, whether used by water or by land, in ships or in fishing boats, in stationary or locomotive engines, on rail-roads or on turnpikes, for manufactures or for agriculture.

There are some interesting points in Mr. Trevithick's testimony, which, together with the description of his boiler, we give below.

Mr. Trevithick is of opinion that high pressure boilers have never exploded by the direct pressure of steam, unless when suddenly produced. In proof of this he states that portable gas holders are one-sixteenth of an inch thick, and ten inches in diameter, and are loaded with thirty atmospheres, or 450 lbs., and yet they never burst, while boilers of this, or greater thickness, have burst when provided with valves loaded to only one-eighth part of this pressure, and less. His theory of explosion is that of water suddenly thrown in foam upon the red hot sides of a boiler.

The new engine of Mr. Trevithick is thus described.

"The fire-place, boiler, and condenser are formed of six wrought iron tubes standing perpendicularly on their ends, encircled the one within the other for the purpose of safety, and to occupy little room, also for keeping the boiler to one constant gauge, with fine distilled water, permanently working without loss, by condensing the steam and never suffering it to escape out of the engine, but returning it from the condenser back again into the boiler every stroke of the engine by a force pump; and were an engine perfectly tight, it would work forever without a replenish of water. But, to supply leaks, a small evaporating apparatus is used for supplying the deficiency with distilled water, which effectually prevents any fluctuation in the height of water in a boiler or collection of sediment, and an impossibility of ever getting the boiler red hot, there being no space for the water to fly out of the boiler but into the condenser; and this is so small, that if, by any means, the force pump did not return the water regularly from the condenser to the boiler, the space in the condenser, by taking one inch in depth of water out of the boiler, would fill and glut the condenser so, that the engine would stand still, and, as the water cannot diminish it does not require a large quantity of water, or water space in the boiler, so necessary in other engines, to guard against fluctuation in the feed, and prevent the boiler becoming red hot. The boiler being considerably less, the strength and room will be increased, and, never getting hot, the engine might be worked with much higher steam; even as high as the pressure which gas holders are charged with, the theory gives a saving of fuel, weight, and room, over low pressure engines of sixteen to one, without a supply of water. I state this to show the probable advantages that will arise from this new engine. For my engine to be one hundred horse power, and to raise sufficient steam, the fire tube must be three feet diameter, which would give the boiler a diameter of three feet eight inches; and that a half inch thick, according to the theory of the strength of iron, would sustain a pressure of 1736 lbs. to the inch, which is four times as great as the gas holders are charged with, and thirty-two times the pressure that the high pressure engines work with at present, which is still farther proof that the explosions have been solely occasioned by the boilers being under water gauge, and heated red hot. If, after boilers have been forced on their trial by cold water pressure, to stand ten times the pressure that they are to be worked at, and a boiler should happen to explode, the shock would be first received by the next surrounding tube, and so on for six successive surrounding tubes; each space between the tubes would admit the steam to escape gently up the chimney without harm, and the outside tube that encircles the whole, might be made of three-quarters of an inch thick, so that it would put injury from explosion beyond possibility. The arrangement of this new engine embraces every advantage that can be wished for; safety, saving of fuel, lightness, little room, cheapness, simplicity, and nearly independent of water, it can be made applicable to any purpose, and much more effectual than horse power, the first cost of erection far less than a quarter the cost of horses, for the duty performed, independent of the difference of expense between coals and horses' feed, because a one horse engine will, by constant work, perform the work of four horses every twenty-four hours."

Mr. Trevithick's claims in relation to locomotion are so exaggerated that we quote before commenting upon them.

"Below is stated the commencement of both my high pressure and locomotive steam engines, with the advantages derived from them. Since 1804, at which time I invented and erected this high pressure engine, up to the present time, little improvement has been made in addition to my own. The first locomotive engine ever seen was one that I set to work in 1804, on a rail-road at Merthyr Tydvil, in Wales, which performed its work to admiration, and a correct copy of which is now in general use on the rail-road. The advantages gained by this improvement was a detached engine, independent of all fixtures, working with five times the power of Boulton and Watt's engine, without condensing water, and the fire enclosed in the boiler surrounded with water, and a forced draught created by the steam for the purpose of working on the roads without a high chimney; and from this was copied all the boilers for navigation engines, which, without it, could not have been made available; this being independent of brick work, light, safe from fire, and occupying little room."

With regard to Mr. Trevithick's attempt in 1804, it is admitted by the English author, Wood, not to have been successful, of which indeed we have the proof in the fact that Trevithick himself proposed to roughen the rims of his wheels to obtain greater adhesion; that Blenkinsop introduced the cogged middle rail, and that such crude contrivances as a chain stretched along the middle of the road, and the jointed leg, were proposed, and tried, to remedy the supposed defect of want of adhesion. It is just possible to see, in the imperfect way in which the escape steam acted in Trevithick's chimney, the germ of the method now employed, with such success, by Stephenson, for producing draught by its current.

Davies Gilbert, Esq. next presented to the committee for examination his judicious remarks upon wheels, springs, draught, &c. published many years since. As they have been for some time before the public, it is not necessary to insert them here. We extract certain additional remarks in relation to economy of steam conveyance, at different speeds, on land and on water.

"The slow conveyance of heavy weights may perhaps be effected by steam on well-made and nearly level roads, so as to supersede the use of horses; but steam power is eminently useful for producing great velocities. It was last year determined by the Society of Civil Engineers, after much inquiry and discussion, that the expense of conveying carriages drawn by horses was at its minimum when the rate of travelling equalled about three miles an hour, and that expense increased up to the practical limit of speed, nearly as the velocity; including the greater price of horses adapted to swift driving, their increased feed and attendance, the reduced length of their stages, and, with every precaution, the short period of their services. On the contrary, friction being a given quantity as well as the force requisite for impelling a given weight up a given ascent, the power required for moving steam carriages on a rail-way remains theoretically independent of its speed, and practically increases but a very little, in consequence of resistances from the atmosphere, slight impacts against the wheels, inertia of the reciprocating piston, &c. The expenditure of what I have termed efficiency, is, as actual force, multiplied by velocity, and the consumption of fuel in a given time will be in the same proportion, but the time of performing a given distance being inversely as the velocity, the expenditure of fuel will, theoretically, be constant for a given distance, and very nearly so in practice. The power requisite for moving bodies through water is in the opposite extreme; here, the mechanical resistance of the fluid increases with the square of the velocity, as do the elevation of the water at the prow, and its depression at the stern.* The oars, or paddles, must, therefore, preserve a constant ratio to the velocity of the vessel; and the force applied will consequently vary as the square of the velocity; and the expenditure of efficiency being as the force multiplied by the velocity; the consumption of the fuel will be as the cube of the velocity in a given time, or as the square of the velocity in a given space; and I have ascertained from the records of voyages performed by steam vessels, that the law is nearly correct in practice: hence the great power required for such steam vessels as are constructed not merely for speed, but also to set at defiance the opposition of winds and seas; while, on the contrary, a very small power will be found sufficient for moving ships of the largest dimensions through the water, at the rate of two or three miles an hour, when their sails are rendered useless by continued calms."

The next witness examined, Mr. Nathaniel Ogle, is joint patentee with Mr. Summers, in a boiler, engine, and carriage, adapted to locomotion on common roads. His testimony bears stronger marks of enthusiasm than of accuracy. He tells us that "rail-roads, except in very peculiar situations, are behind the age;" and we are disposed to believe that he gives full credence to his own remark. He does not seem to have been particular in measuring speeds or estimating weights, and treats the subject of tolls with considerable contempt. "I have paid near London, when trying experiments, a shilling or two, and I made no inquiry. I remember going out of London, throwing one man a shilling, and another two, being too much occupied to trouble myself about the matter."

The desideratum which Mr. Ogle considers to be realized in his boiler, is the combination of a great extent of heating surface with a limited space and perfect safety. The working pressure is 247 lbs. to the square inch on the safety valve. A description of the boiler is given which we cannot understand. It is said to present 250 square feet of fire surface in a space of three feet eight inches high, three feet long, and two feet four inches broad, and to weigh eight hundred weight.

The carriage has three wheels, the centre wheel being a guiding wheel. The adhesion of only one wheel is employed except in rising hills. The weight of the carriage and engine, with water and fuel, is stated at about three tons.

The results of trials of speed are given as from thirty-two to thirty-five miles an hour over a wet road with patches of gravel, which speed might have been continued for an indefinite time, or have been increased over a good road to forty miles. "From the turnpike gate at Southampton, to the four mile stone on the London road, a continued elevation, with one very slight descent, at a rate of twenty-four and a half miles an hour, loaded with people." "Ascended one of the loftiest hills in the district, near Southampton, at sixteen and a half miles an hour." "Ascended a hill with a soft wet bottom, rising one foot in six, at rather a slow rate."

A slope of one in six is about nine and a half degrees! When we consider that the greatest slope in our turnpike which crosses the Allegheny mountains is not greater than about five degrees, we are tempted to inquire where such a slope was found in the neighbourhood of London. The remarks of Mr. Ogle on the relative effect of horses' feet, and of the wheels of carriages upon turnpikes, are very judicious, but as we shall have occasion to refer to similar ones, it is not necessary to detail them.

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* This is certainly an error.—Rev.

The next witness, Mr. Alexander Gordon, is an engineer, who states his principal experience to have been derived from the experiments of Mr. Gurney. He describes the two patents taken out by his father in 1822 and 24, both of which were unsuccessful. The first was a locomotive within a drum which it rolled along, propelling a coach in front. The second was a carriage moved by iron propellers.* Both the schemes proved failures.

The information given in relation to the relative wear of roads by wheels and by the feet of horses, seems to be founded on data of doubtful authority, and not skilfully used. The facts relating to the relative wear by steam coaches and the ordinary coach are of a different cast, and, to all appearance, have been drawn from close observation; the inference from them is that the wheels of a steam coach, the driving wheel included, do not do more apparent injury than those of the ordinary coach.

The testimony of Mr. Joseph Gibbs, engineer and patentee of a new boiler, and who was the next witness examined, presents no particular point of interest except that which relates to the freedom from slipping of the driving wheel in a locomotive; the carriage upon which the observation was made was Mr. Gurney's.

After travelling over a flinty road the tire was examined and found to be free from furrows extending around the wheel, which would have been produced had the wheel slipped.

The examination of Thomas Telford, Esq. is the next in order; it occupies but little space. The subjects to which it is directed are the relative injuries to roads by horses, by common carriages, and by steam carriages.

Mr. Telford considers that a horse does much more injury to a good road than the carriage which he draws, and that the mere pressure of a carriage can, in such a case, produce little effect. With regard to the question of the relative wear by common and by steam carriages, he professes a want of experience, but gives a qualified opinion in favour of the less injury which would be done by a steam carriage, than by a common coach of the same weight.

We next have the testimony of the partner of Mr. Ogle.

His statements upon points noticed in Mr. Ogle's testimony agree tolerably except as to speed, in the statement of which he is not very clear. He places the average speed at nearly ten miles an hour, the locomotive carrying nineteen persons. Then speaks of going up a hill, of a slope of one in twelve, at the rate of fifteen miles per hour. The discrepancy he attributes to the variation in the intensity of the fire. After a change made in the fire place is spoken of, Mr. Summers states that his carriage went frequently at the rate of thirty miles an hour for four miles and a half.

He gives a most favourable statement of the performance of his boiler, viz. "We have never found it necessary to clean it yet: it has been in operation more than twelve months." "We have had water of every description." "Every time we have arrived at our journey's end, we opened a cock communicating with the bottom of the boiler; perhaps we do not give the matter (sediment) time enough to rest: it is all blown out at the pressure of 240 lbs. on the square inch."

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* Both these locomotives are figured in the lithographic print entitled the "Progress of Locomotion. By Alexr. Gordon, Engineer."

The method of urging the draught is thus spoken of:

"Instead of blowing our waste steam into the chimney, in order to produce a draught, we have a fan or blowing machine, which is driven by the engines when in operation, and this gives us intensity of heat in the furnace. The waste steam from our engines goes into a double casing round the furnace; we admit a small portion underneath the fire bars of the grate, and the remainder is allowed to expand itself into the double casing, after which it comes over the top of the fire, and escapes in the form of invisible vapour.

"Then, in fact, you arrive at the same result, but with this difference, that you increase the draught of the fire by using a certain quantity of the power of your engine, whilst those who introduce the steam into the chimney increase the draught by a power which you throw away? We have tried it in both ways, but we find this the most advantageous, because in those carriages in which the steam is driven into the chimney to produce a draught, the aperture is so much diminished in order to produce velocity of current and corresponding increase of draught, that the waste steam is choaked in escaping from the engines, and produces a greater loss of power than by working the fan."

Mr. Summers' remarks drawn from his experience in the different varieties of road, &c. will be read with interest. He adheres to the slope of one in six, upon which we have remarked, and says that he has measured it: all men are liable to errors, and we repeat that one in six is nine and a half degrees.

"From your experience in steam carriages, do you conceive that it will be necessary to make any alteration of the present roads, such as paving them for the purpose of this mode of conveyance? No, certainly not; we have found that our vehicles will travel over every kind of road with great velocity, and up the steepest hills. From observation which I have made very minutely on the operations of the vehicle, my decided opinion is, that if the common roads were put into a tolerably good state of repair, we should be able to carry all the goods which a rail-way would be able to carry, and at much less expense, taking into consideration the original expense of the rail-way, and its continued wear and tear. I believe I have ascertained, from a correct source of information, that every yard of rail-way loses on an average about four ounces per year in weight, when it is in full operation. This loss arises from oxidation, and the action of the great numbers of wheels of the carriages that pass over it."

"Have you travelled over pavements? Very frequently."

"Did you find that your carriage travelled with greater ease over them? With much greater ease."

"Supposing you had a pavement to run on, what increase of power should you gain by running on that rather than on a common Macadamized road? We find that when we are travelling on a rough, bad pavement, we do not consume more than one-fourth of the steam we do on a gravelly soft road."

"You conceive you increase your power three-fourths on a paved road? Yes."

"What steepness of hill have you ever ascended? One foot in six; I measured it myself: that is, the hill at Shirley."

"Were there any symptoms of the wheel slipping in that case? Not the slightest: we had both the wheels in gear at the time we ascended it."

"At what velocity did you ascend it? At a velocity of nearly five miles an hour."

"What weight had you? We had fourteen or fifteen persons on the carriage."

"Did you find any difficulty in working? Our engines worked with perfect freedom."

"What distance did you travel on that ascent? The hill is about 200 yards long."

"You are now improving the form of the carriage—are you not? Our present operations are in improving the form of our vehicle, and the arrangement of the different parts of the machinery."

"For what number of passengers will your present carriage be calculated? Eight inside, and sixteen outside passengers."

"How many wheels have you? Our present vehicle is on three wheels; our proposed carriages will be on four wheels."

"In what space can you turn on a road? We have frequently turned entirely round on the London road leading from Southampton, in the space in which a post-chaise can turn, or rather less."

"Supposing you were travelling at the rate of ten miles an hour on a level road, in what number of feet do you suppose you should be able to stop your carriage entirely? We should be able to stop the vehicle in the space of twelve feet. I have ascertained this from experiment: when we were descending Staine's bridge, which is very steep, one of the crowd fell down in front of the vehicle, very near the vehicle; we immediately reversed the action of the engines, and the man escaped without any injury."

"When you state that you can stop in twelve feet, is that by reversing the action of the engines? No; by merely shutting off the communication between the boiler and the engine."

"But supposing you were in such a situation that it would be requisite to stop in a much shorter distance, could you do it instantaneously by reversing the engine? We could certainly stop in the space of three feet by reversing the engines; but it would not be prudent to do so in less, as it might endanger the lives of the persons on the vehicle by their being pitched or thrown forward."

Mr. Summers proposes tolls in proportion to the number of passengers carried, making those of steam coaches only one-half those of stage coaches, carrying the same number of passengers, on the ground of the less injury which they do to the road.

Mr. Stone, next examined, is the engineer of Sir Charles Dance's steam coach.

He states that they have run regularly for five months between Gloucester and Cheltenham, (25 miles?) with the occurrence of only a single accident, the breaking of an axletree. The greatest weight drawn he rates at eleven tons, and this was drawn at the rate of five to six miles an hour; the weight of the carriage was two tons. They have carried between three and four thousand passengers. This coach had been reported by the surveyor of the Gloucester and Cheltenham road as a nuisance, from the alarm which horses on the road took at it, noise, &c.

Mr. James M'Adam was next questioned, particularly in relation to the relative effect of wheels, and of the feet of horses, upon roads, and upon the method of charging tolls upon steam carriages. Pleading want of experience in relation to the effects produced by steam carriages, the information which he gives in relation to the latter question is conjectural. That referring to the effects of common carriages upon roads, and to the construction of these latter, will be read with interest.

"Have you made any experiments, or are you able to give any information to the committee, as to the comparative wear of roads, or injury to roads by carriages and horses passing? I have generally found that horses' feet do very great injury to the surface of a well-made road; and I am of opinion that a carriage, with properly constructed wheels, does less injury to a road than the horses' drawing.

"Would you explain what the operation of the injury done to the road is by travelling on it: is it the wear of the road, or the displacement of the materials? Both take place; the wheels, to a certain degree, wear out the material, but, upon a road properly constructed, and that has become consolidated, and the surface smooth, that wear is very small and gradual; the injury to the road from the horses' feet, more especially upon gravel and flint roads, arises, particularly in dry weather, from the knocking up and displacing the materials upon the surface, and each succeeding journey adds to the evil, and were it not for the effect of the wheels following the horses in mitigation of that evil, we should have the flint and gravel roads all loose throughout the whole summer."

"But the wheels of the carriage do not actually follow in the track of the horses? But in roads of much thoroughfare, especially near the metropolis, other carriages do."

"On the metropolis roads have you made any new regulations as to the mode of charging tolls, by weight or otherwise? In the last act passed for the metropolis roads, the toll was put upon the horse drawing, and a regulation as to the formation and breadth of the wheels expressly enacted, by which all wheels were required to be not convex, but a perfectly flat surface, with no projecting nails; but, by the powers granted to the commissioners in that act, that perfectly flat surface was mitigated to a surface not exceeding a quarter of an inch from the flat surface; to meet the practical effect arising from the wear of the wheels upon the road, and to prevent litigation at the several gates, by applying a gauge, a toll of 3d. per horse for each seven miles is payable upon a six-inch wheel so constructed; a quarter more upon a wheel so constructed of four inches and a half in breadth, and a half more upon a wheel less than four inches and a half. Those additions do not apply to stage coaches, or carriages with springs. The toll upon all horses drawing carriages and coaches with springs is 3d. a horse for seven miles, whatever may be the breadth of the tire."

"You have had no reference to the weight of the carriage drawn in your rate of the tolls? There is no reference to the weight drawn in any wagon or such like carriage, provided the wheel is of the construction required by the act, and the result of some years' experience proves that no injury whatever is sustained upon a well made road, from any weight practically carried in wagons, or such like carriages, with wheels as described."

"You do not mean that the committee should infer weight is of no consequence, but that the power of the horse will be your guard against an overweight being drawn? Yes; the toll being laid per horse, I consider that the penalty in the shape of toll per horse, more than compensates for the injury done by the weight. Before those regulations took place, the roads, in truth, sustained an equal pressure, from the well known fact that the weighing engines were universally compounded for by all the carriers, and that the roads after these regulations, had no greater but even less weights to sustain than before that took place, and it was observing that fact which induced the commissioners of the metropolis roads to do away with all the weighing engines."

"Do you know whether the Holyhead road commissioners are trying to do away with the necessity of weighing engines? Upon the trusts, on that line of which I am surveyor, the trustees have done away with all the weighing engines, and the happy result of compelling the wagons to set out and arrive upon the metropolis roads with properly constructed wheels, has had the effect of enabling the trustees upon all the roads within a circle of fifty to eighty miles, to dispense with the weighing engines; also, because if the wagons set out and arrive in the metropolis district with a properly constructed wheel, it was not worth their while to alter it, but to travel throughout to Cambridge, Newmarket, &c. with the same wheel; and the benefit of the metropolis wheel has extended itself in consequence."

"Then supposing a broad wheel wagon with dished wheels was to pass through your turnpike, what rate would be charged? It would be charged the highest rate of a narrow wheeled wagon."

"Have you heard any complaints from the wagon masters of the regulation of the form of the wheel? On the contrary, a few days since, we had a petition most numerously signed by the wagon masters from Norwich, Cambridge, Newmarket, &c., requesting the trustees of the Wadesmill road to dispense with the use of their weighing engine, they having found by experience that the wheels required by the metropolis commissioners, were not only best for the road, but the most advantageous for themselves to use, and in consequence of that application, on Friday last, the only remaining engine on the roads of which I am surveyor, was ordered to be abandoned."

"Can you state the weights of a loaded stage coach, and a loaded wagon, and a loaded van, on the average? I should state a stage coach loaded, at from two and a half to three tons; a wagon from five tons to seven and a half."

"Does that include the weight of the wagon? Eight tons would; I should think the weight of the vans about four or five tons."

"Have you observed the operation of wheels when they are dragged? Yes; they are injurious upon roads newly coated certainly, but upon an old road, I mean a road that has become consolidated upon the surface, the injury, with proper skid pans, is but small, and confined, of course, to one side of the surface of the hill."

"Do you think the efficacy of your toll in protecting the road is equally applicable to a heavy van as to a loaded coach? I think that the toll per horse will always be a sufficient guard for the weights drawn; the van being on springs does infinitely less injury, in proportion, than such a weight without them."

"But if the injury to the road proceeds from the weight the horses have to draw, the same rate of toll would not be applicable to a carriage of two tons and one of six tons, both being drawn by four horses? Certainly not; but that is a supposition hardly fair to be taken, because we conclude that the additional weight requires additional horses."

"But in practice the vans pass all through the country with only four horses, and the coaches equally with four horses? That is true; the coaches go at a much more rapid pace."

"Do you think that the velocity with which a coach goes, has any thing to do with the wear of the road, or is it not actually less injurious in proportion to its velocity? In some instances, where any blow takes place, the speed does more injury to the road by crushing the materials."

"You did not contemplate the general use of vans when that act was drawn up? No; not that they would come into such general use."

"What proportion of the injury to the road do you think takes place from the changes of the atmosphere; frost and wet, has it any material effect? Yes, decidedly, in chalk soils in particular; at Royston, and through that country, a great and serious injury takes place upon the breaking up of all frosts, nor can we, by any care, or attention, or strength of surface of the road, prevent that taking place; it comes in a very eccentric manner, and breaks up one year at one part of the road, and another at another, occasioned in a great measure by the standing of the water in the sub-soil; and I suppose also, by the way in which the wind is at the time it freezes. It is the modern practice of road making to abstain from all general repair of the roads from the middle of April until the middle of October; during that period, the only repairs that ought to take place are partial coatings, necessary from accidental circumstances. As soon after the middle of October as possible, the general coating takes place in pieces of the road at a time, so as to interfere and interrupt as little as possible with general travelling; and we endeavour, by the month of February to have the whole of the coatings put on; in no instance above a sixth part at a time."

The quotations from the remarks of Mr. John Macneil, assistant engineer to Mr. Telford on the Holyhead road between London and Shrewsbury, and London and Liverpool, are, we think, of much interest.

"On an average line of road, of not less than 100 miles, on which, in many places, materials of very inferior description must have been used, both in its formation and subsequent repair, what is the maximum weight per wheel (say if not less than four inches width of tire,) which should be carried on any kind of carriage (carriage weight included,) without risk of injury to the road? On a road, such as here described, the injury will be considerable by any wheel passing over it, but without a more defined statement of the quantity and quality of the materials used, I do not think this question can be answered with any degree of certainty. On all gravel roads, however, made without a foundation or bottoming, I should say the weight on a four inch wheel, should not exceed fifteen cwt., and on a wheel less than that ten cwt. On the generality of roads, throughout the country, I do not think it would be safe to run a carriage with almost any width of wheel if the load much exceeded ten tons; in fact there are some bridges even between London and Birmingham, that it would be running a risk to pass over with a carriage weighing ten tons."

"Can you, from observation, say what proportion the breadth of the tire of wheels should bear to the weight? The breadth of tire in proportion to the weight, will depend entirely upon the description of road over which the carriage passes; on the road lately constructed by the parliamentary commissioners of the Holyhead and Liverpool roads, at the Highgate Archway, I have frequently observed wagons, carrying upwards of six tons, pass; the weight of each wheel on the road was then about thirty cwt., and though the bearing of the wheels, from the cause I have before stated, was not more than three inches, the effect produced was imperceptible. The pressure, in this case, was ten cwt. on every inch, which is unquestionably too much for the generality of roads; but if we take the road from London to Shrewsbury as a criterion to judge by, I should say that a wheel ought to be an inch in width for every ton that a carriage and its load weighs; and that if every carriage that now travels that road was limited not to exceed that proportion, the roads would be better, and maintained at a cheaper rate than at present. According to the average weight of coaches and wagons, as stated, I have calculated the following table, showing the weight at present carried on each inch of bearing, and what I conceive might be the breadth of the different wheels if they were made cylindrical, with an even bearing, and in the proportion of one inch of width for every ton including the carriage."

Description of carriage.	Velocity in miles per hour.	Weight, on an average, in tons.	Breadth of the wheels, in inches.	Presssure of each wheel, in cwts.	Pressure on each inch, in cwts.	Breadth of wheel, calculated in the proportion of five cwt. to the inch.
Mail coach,	9 to 11	2	2¼	10.0	4.40	2
Stage coach,	8 to 11	2½	2	12.5	6.25	2½
Van,	6 to 7	4¼	2½	21.25	8.29	4¼
Wagon,	2½ to 3	6	9	25.0	2.77	6
Ditto,	2½ to 3	4½	6	22.5	3.75	4½
Ditto,	2½ to 3	3½	4	17.5	4.37	3½

"State your opinion as to the relative wear of a road by two carriages, both drawn by four horses, one carriage of two tons weight, with two inch tires, the other four tons, with four inch tires? My opinion is, that the wear of the roads would in each case be the same, as far as it was affected by the wheels of the carriages, probably rather less, by the carriage carrying four tons, on four inch wheels, than by the carriage carrying two tons with two inch wheels; but it must be recollected that both the carriages are supposed to be drawn by the same number of horses, and as the horses drawing the carriage of four tons must use greater exertion than those drawing the carriages of two tons, I am of opinion that the aggregate wear of the road would be more by the transit of the four ton carriage, than by that of the carriage weighing two tons."

"How would the foregoing answer be affected by an increase or decrease of velocity in either carriage? If the road over which the carriages are drawn be hard, solid, and smooth, I think there would be very little increase of wear from the effect of the carriage wheels by an increase of velocity; but if the road should be uneven or rough, there would be an increase of wear, in consequence of the impetus, or blow, with which the wheels would strike the road after passing over the inequalities in its surface, particularly if the carriages were made without springs; but whether the road be a good or a bad one, the wear occasioned by the feet of the horses will be greater when they travel with an increased velocity: for a coach horse which travels at the rate of ten miles an hour, works on an average 270 miles in a month, and wears out in that time about four pounds of iron in shoes; whereas a wagon horse, which travels at the rate of three miles an hour, and works twenty-six miles a day, for four days in the week, goes, on an average, 416 miles in the same period of time, and wears out 4.8 pounds of iron. If the coach horse travels the same distance, the wear would be six-sixteenths, which exceeds the wear of the wagon horse one thirty-sixth. In the same way might the relative injury caused by the wheels of the wagon and the coach be ascertained."

"What is the operation of the atmosphere on roads? Well made roads, formed of clean hard broken stone, placed on a solid foundation, are very little affected by atmospheric changes; weak roads, or those that are imperfectly formed with gravel, flint, or round pebbles, without a bottoming or foundation of stone pavement, or concrete, are, on the contrary, much affected by changes of the weather. In the formation of such roads, and before they become bound, or firm, a considerable portion of the sub soil mixes with the stone or gravel in consequence of the necessity of putting the gravel on in thin layers. This mixture of earth, or clay, in dry warm seasons, expands by the heat, and makes the road loose and open: the consequence is, that the stones are thrown out, and many of them are crushed and ground into dust, producing considerable wear and diminution of the materials; in wet weather also, the clay, or earth, mixed with the stones, absorbs moisture, becomes soft, and allows the stones to move and rub against each other when acted upon by the feet of horses, or wheels of carriages. This attrition of the stones against each other, wears them out surprisingly fast, and produces large quantities of mud, which tend to keep the road damp, and, by that means, increase the injury."

"Supposing the actual wear or deterioration of a road to be represented by 100, and that only coaches, vans, and wagons, have passed over it during any given period, in what proportion would you estimate the effects; first, of atmospheric changes; secondly, of the carriage; thirdly, of the horses? This question can only be answered in a general way; no two lines of road would probably give results at all similar: much will depend on the manner in which the road is constructed, the materials of which it is composed, the care bestowed on its drainage, and whether it be in an open situation, or shaded by trees. If the road be properly made, and in an open situation, the injury arising from the atmosphere will be little, compared with the actual wear caused by the wheels of carriages and the feet of horses, probably not ten per cent. during the year; whereas, on weak roads in clay countries, every shower loosens the materials of which the road is composed, and causes considerable wear, perhaps thirty per cent. or even more in some situations, where the road is shaded by trees; to get at something like an average proportion between the wear occasioned by horses' feet and the wheels of carriages, I have procured the following facts: the coaches which run between London and Birmingham, require a hundred horses, on an average, to work the up and down coach; the horses are generally shod by contract at about 2s. 6d. (55 cts.) per horse per month; those near London are much larger and heavier, and therefore require heavier shoes than those twenty miles out of London, and from thence to Birmingham; near London, in the flint districts, the wear of horses' shoes is much more than it is in the quartz and limestone countries. At Stoney Stratford, the weight of the four shoes of a mail and stage coach horse averages five pounds, and when taken off at the end of about twenty-eight days, they weigh very nearly two pounds: in this period the horses run 252 miles. At Towcester, Weedon, and Daventry, the weight of the new shoes is one pound and a half each, and, when taken off, they weigh nearly three-fourths of a pound; the length of time which they remain on is about thirty days; this would give a wear of three pounds per horse per month, but if the greater wear near London be considered, I think it would not be too much to allow the wear equal to four pounds per horse per month, which for one hundred horses for ten weeks, would give a wear of 1000 lbs. of iron. The hind wheels of the coaches are mostly four feet eight inches in diameter, and the front wheels, three feet. The width of tire, I before stated, is about two inches, and when new, the thickness of the iron is three-quarters of an inch. These wheels are found to last from two to three months, according to the state of the weather, the workmanship and quality of iron, (about twenty years ago they did not last seven days on an average;) suppose they now last ten weeks, in that time the tire is worn down to one-sixth of its original thickness. This would be equal to 163.4 lbs. or 326.8 for both coaches; this would be to the wear of the horses' shoes as 326.8 to 1000, or as 1 to 3-14ths nearly; now if the injury done to the road by the horses' feet and the wheels of carriages be estimated in the same proportion, I think it would probably be near the actual effect produced; that is to say, the injury done by the wheels of fast coaches is to the injury done by the horses which draw them, as one to three, in round numbers. The effect produced by slow carriages and horses is different: a wagon drawn by four horses, which travels regularly from London to Daventry at the rate of three miles an hour, is worked by fifteen horses; the wagon weighs twenty-five cwt. and carries, on an average, sixty-seven cwt.; the hind wheels are four feet eight inches in diameter, and the front ones four feet; the breadth of the wheels is six inches; they are nearly upright, but not cylindrical. The iron tire when put on, weighs on the fore wheel 285 lbs., on the hind ditto, 336 lbs., making 621 lbs. When removed, the weight is, on the fore wheels, 144 lbs., on the hind ditto, 168 lbs. making 312 lbs.; wear in five months, 309 lbs. The number of miles travelled in this time is 6,048; the shoes that are put on the horses employed to draw this wagon, weigh, when new, from two pounds and a half to three pounds each; the average of a great many gave two pounds and three quarters, and when removed one pound and a quarter. They last from four to six weeks, according to the weather, and state of the road; but we may assume five weeks as an average, and the wear in that time for each horse six pounds, and for fifteen horses for five months it would be 360 lbs. The proportion, in this case, would be as 309 to 360, or as 1 to 1.16, or nearly one to one and a fourth on the generality of roads: therefore I would say the proportion of injury would be nearly as follows, when travelled by fast coaches—

Atmospheric changes, - - -	20
Coach wheels, - - - -	20
Horses' feet that draw them, - - -	60
	100

And when travelled by wagons—

Atmospheric changes,	20
Wagon wheels,	35.5
Horses' feet that draw them,	44.5
	100

"What is the effect of travelling by coaches and horses? whence, and in what proportion, does the injury or deterioration arise; is it from the crushing of materials; their actual wear; their displacement? If the wheels of carriages be properly constructed, and cylindrical, the friction, and consequently the wear on the surface of a well made road, will be very little, and there will be no injury from displacement of materials, except what may arise from the few surface stones that will sometimes be started out by the feet of horses on steep hills, when they are obliged to exert a great force to draw up a heavy load. When stones are thus thrown out on a hard and solid surface, the wheels of heavy carriages will crush them, and cause an injury which would be much more than that caused by the actual wear of the wheels passing over the surface. If the road be weak, or elastic, and bend, or yield, under the pressure of the wheels, the particles of which it is composed will move and rub against each other, or perhaps break by the action of heavy wheels over them. On such roads, I conceive the injury caused by steam carriages will be much greater in proportion to the injury caused by light carriages drawn by horses, than it will be on solid firm roads. In one instance, where an accurate experiment was made, the wear was found to be four inches of hard stone, when it was placed on a wet clay bottom, while it was not more than half an inch on a solid dry foundation, (formed as described in the report of the select committee on the Holyhead road, on the 30th May, 1830,) or with a pavement bottom, on a part of the same road, when it was subject to the same traffic. On the Highgate archway road, before mentioned, the annual wear does not appear to be more than half an inch in depth. Now, as this road is very little affected by wet, in consequence of its peculiar construction, and the care bestowed on its drainage, I attribute almost the whole of the diminution of materials to actual wear. On many roads, where the sides are weak, great injury arises from the crushing of materials, particularly by the action of wagon wheels. In frosty weather weak roads very frequently suffer more in one month than during all the rest of the year. In such cases, the injury is caused by the wheels of carriages, and not by horses' feet."

"The details of various kinds of steam carriages have been given to the committee; all act without propellers; without projections on the wheels; with cylindrical wheels; some with greater or less breadth of tire, even six inches wide; the power is applied either by crank or wheels to one or two propelling wheels, accordingly as greater or less force may be required. Some of the experimental carriages had three, some six wheels; all will have four wheels. Some have the engines in a separate carriage, and draw the load; some carry the load and engines on one carriage. Taking the above circumstances into consideration, which would be most injurious to a road—a stage coach, drawn by four horses, weight of coach three tons, horses two tons, breadth of tire two inches and a half; or steam coach, wheels four inches tire, weight four tons; in both cases velocity ten miles per hour? Taking for granted that the injury which a road sustains by the wheels of carriages, and the feet of horses is proportional to the wear of iron on the wheels and on the horses, and that the statement before given as to the actual wear on each be found correct, I would say the injury done to the road by the steam carriage weighing four tons with four inch wheels, would be less than that occasioned by the coach weighing three tons, drawn by four horses."

"Would it be beneficial, or otherwise, to the roads, that steam carriages, drawing heavy weights in carriages attached to them, should be substituted for wagons drawn by horses, supposing that the weight of the drawing or propelling carriage should not in any case exceed the weight of the number of horses that would have been used to draw a corresponding weight, *e.g.*"

Wagon,	8 tons.
Eight horses, 15 cwt. each,	6 ditto.
	14
On steam carriage,	4
Carriage drawn,	10
	14?—

I am of opinion, that if the steam carriage and its accompanying carriage be constructed with wheels of a proper width, and of the same diameter as the wagon wheels, and travel with the same velocity, that the injury on well made solid roads will not be more than that caused by the wagon and horses: in fact, if the proportion of injury before stated be correct, it will be less; but it must be recollected that weak roads suffer more than solid ones from the heavy pressure of wheels, and, in such cases, the steam carriage and its tender would be more injurious."

"In descending hills, steam carriages can regulate their velocity by reducing the action, or number of revolutions, of the wheels; this acts as a drag, but with this advantage to a road, that the wheel moves continually round: which would be most injurious to a road, the descent of a carriage dragged as usual (not omitting the operation of horses' feet,) or the steam carriage dragged or regulated in the mode described? Not having seen a steam carriage descending a hill in the manner described, (that is, regulated by the action of the engine on the wheel,) I cannot give a satisfactory answer to this question; but, as far as opinion goes, I should say that the joint action of the horses and drag would be more injurious than the steam carriage, the motion of which was regulated in the above manner, provided the wheels were of the proper width, and the total weight not greater than that of the coach and horses."

The plan of tolls proposed by Mr. Macneil is given in the following extract.

"The toll which carriages propelled by steam, or by any other mechanical means, should be required to pay, ought, in my opinion, to be in proportion to the injury they would do to the roads compared with that done by the present description of carriages, and the horses employed to draw them, without reference to the weight or quantity of goods carried; but, as I before stated, I do not believe an accurate estimate can be, at present, formed as to the injury that roads may sustain from steam carriages, compared with the injury done to them by coaches drawn by horses. It may, however, I think, be safely assumed that the injury done to a road by a steam carriage would not be greater than that occasioned by a stage coach drawn by horses, the weight of the engine and its load being supposed not to weigh more than the stage coach, together with its load and horses. If this be granted and an act passed limiting the width of wheels in a certain proportion to the weight carried, there would not be much difficulty in arranging a scale of tolls applicable to steam carriages, which would put them on an equitable footing with carriages drawn by horses. If, for instance, a proportion, such as I have already mentioned, be adopted, viz. that a wheel should be an inch in width for every five cwt. it has to support, and a toll charged for each inch equal to the amount charged for a horse drawing in a carriage which travels with the velocity of the engine, it would, in my opinion, be a fair and equitable toll, at least for some years, or until a correct proportion of injury was ascertained by experience and observation, when it might be altered or amended according to circumstances. This mode of charging toll would be extremely simple, and not likely to be misunderstood by toll-collectors, or to occasion any disputes; but there should be a heavy penalty attached to the proprietors of steam carriages if they put a greater weight on the carriage than the wheels were intended to carry. If the engine, instead of carrying the load, draws one or more carriages after it, the toll should be collected and charged on each carriage in a similar manner as it is charged on the engine, that is, in proportion to its wheels. An example will illustrate my meaning more clearly: suppose an engine, together with its load, to weigh nine tons (which is about the average weight of two stage coaches, including the weight of the horses which draw them) to pass through a toll gate where horses drawing coaches are charged 6d. each, the toll on the two coaches, would be 4s., and of the steam carriage 4s. 6d. Suppose that the engine, instead of carrying the load, draws a carriage after it, and that the weight of the engine is five tons, with five inch wheels, and of the accompanying carriage four tons, with four inch wheels, the toll of the engine would be 2s. 6d., and of the tender 2s., making 4s. 6d. as before. The only objection I can see to this mode of charging toll on steam carriages travelling over the turnpike roads, would be, that, in the event of their being able to carry a greater number of passengers at a cheaper rate than the present description of carriages drawn by horses, it would lessen the amount of toll collected, as a fewer number of carriages would do the work, and many persons who drive their own horses would travel by them if found cheaper to do so; and this circumstance, although it would not affect the state of repair in which the road was previously maintained, might lessen the value of property invested in the different turnpike trusts throughout the kingdom, which is a very considerable sum; but such circumstances should not militate against an invention likely to prove beneficial to the country at large."

Mr. Macneil states that he saw Mr. Gurney's steam coach carrying eight or ten persons over one of the worst roads " in the country," at the rate of five or six miles an hour; he saw several horses both under the saddle and in harness pass Mr. Gurney's carriage without noticing it.

Mr. Macneil is of opinion that no road should have an ascent greater than one in thirty (about two degrees,) or one in thirty-five, and that the expense of such roads would be saved in a few years in the diminished labour of transport. The ascents between London and Birmingham are given as sometimes one in fifteen (about three and two-thirds degrees.)

The testimony of Col. Torrens, a member of the committee, and the last witness examined, is directed to the effect which would be produced upon the agricultural interests by the substitution of steam power for horse power. Upon such a subject there is much room for speculation, and we consider the analysis of this report as terminated without adding one more to the speculative opinions for which this new subject has already given room.

B.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MAY, 1832.

With Remarks and Exemplifications, by the Editor.

(Continued from p. 333)

36. For *Fastenings for Bedsteads, Sofas, &c.;* John P. Allen, Manchester, Essex county, Massachusetts, May 19.

The nature and antiquity of this invention will be rendered apparent by the claim, which is to "the application of the right and left hand iron screw to bedsteads, sofas, and couches, for the purpose of fastening together into solid frame work." We have neither time nor inclination to ascertain how many patents have been issued for putting bedsteads together by right and left handed screws, but recollect several; in some of them it is proposed to make the screws of wood, and in others of brass. Whether or not *iron* has been mentioned we cannot say; and, if not, the present patentee has the "forlorn hope" of sustaining his claim, by a strong material, it is true, though not by any thing which he has *invented* or *discovered;* he having merely substituted one well known material for another, which attains the same end, and by the same means.

37. For a *Machine for Cutting Laths;* Ira Carpenter, Cincinnati, Hamilton county, Ohio, May 21.

This machine is described with sufficient clearness, but the drawing which accompanies it is unworthy the name.

Two methods of constructing the machine are mentioned, in both of which the cutting knives are made to revolve. According to the first, or main plan, a quadrangular frame is to be made by joining four pieces of timber strongly together; this frame is to be hung by a shaft, or pivots, passing through the middle of its sides. Across one, or both, of its ends a long knife, say one of four feet, is to be fixed, and by this knife boards are to be cut into laths. The frame is made to revolve by means of whirls on its shaft; the cutting knife is to have such a curve on its outer side as is due to the circle in which it revolves, and the inner side is to be made concave, having regard to the necessary strength. The cutting edge is not to be straight, but hollowed, so that when its ends come in contact with the board, its middle may stand at a distance of two inches. The knife should be from three to five inches in width.

The board to be cut is placed upon a suitable bed piece, with which the knife, in its revolution, comes nearly into contact. The board is made to advance against a stop, which gauges the thickness of the lath, being forced up by a rack.

The second method of forming the machine is to take a beam of about nine feet in length, and to hang it so that it may revolve upon a shaft, or gudgeon, passing through the middle of it. Along each of the ends of this lever a knife is bolted, of sufficient length to cut a lathe. These knives may, in this case, be straight on their edges, and may be made to cut at one end first.

The claim is to the construction of the concave and convex knife, and its application as described; and also to the combination and application of the other parts to the purposes set forth.

On the 16th of March, a patent was granted to Simon Willard, of Cincinnati, for a machine in most points similar to this, the main difference being in the concavity of the knife. See p. 163.

38. For a *Washing Machine,* called the double cylinder wash-

ing machine; John S. Pulsifer and Ebenezer Pulsifer, Ipswich, Essex county, Massachusetts, May 21.

This machine is so truly a counterpart of that patented by Mr. Simon Savage, on the 11th of April last, and described p. 236, that we shall merely refer the reader to the account there given, for a full display of the present invention.

39. For a *Stereotype Block;* Bradbury Hackett, Boston, Massachusetts, May 21.

This is entitled an improvement in moving forward the *hookers* of the stereotype block.

The two moveable hookers have shanks to them, which are placed in excavations made for the purpose, in the block. These shanks are surrounded by a spiral spring, which may be made to act in either of two ways; it may force the hookers against the edges of the plate, so as to hold it by their continued pressure; or it may force them from the plate, and be kept up against it by the action of a cam, or turnbuckle, against a plate of brass, by which they are connected. The drawing represents the former arrangement. There is a cam, or turnbuckle, which, when a key is inserted, acts upon the middle of a piece of brass, the ends of which force the hookers against the plate, the cam being retained in its place by the falling of its end into a slight depression on the brass plate. We should think the first described arrangement the best, as the distance to which the hookers are carried cannot, by this latter mode, be varied by the spring, and is not, therefore, so well adapted to any difference in the width of a stereotype plate.

Instead of using the spiral springs, it is proposed sometimes to substitute a bar of steel for that of brass, giving to it such a form and thickness as shall cause it to serve the double purpose of lever and spring.

The claim is not to the individual parts, but to the general arrangement of them for the purpose to which they are to be applied.

40. For a method of *Attaching Leather Soles to Boots and Shoes of India Rubber;* Wait Webster, city of New York, May 21.

An in-sole of leather is to be put within the shoe or boot, and a corresponding out-sole and heel are placed on the outside, when the whole is to be attached together by nailing, pegging, or sewing, in the ordinary modes of performing these processes.

41. For a *Machine for Sawing Timber;* Jackson Blood, of Trumbull, and Samuel A. Hurd, of Huntingdon, Fairfield county, Connecticut, May 22.

What is intended for a description of this machine does not explain either its construction or mode of operation; and the drawing, although it is good as a picture, is very far from supplying the defect of the specification. It appears, however, that saws are to be stretched in a saw frame, and that this saw frame is to work horizontally within the general frame work of the whole apparatus. A horizontal shaft, with its proper gearing, crank, and pitman, is to vibrate the saw frame. The timber, according to appearances, is to be placed, by some means, under the saw, the frame of which, as the teeth enter, is to sink down upon it. The thing, as represented, appears to be altogether incapable of being worked, and will, in this case, be secure from all successful attempts at piracy.

42. For a *Machine for pressing, fluting, and bending, Tortoise Shell, Horn, and other Combs;* Reuben Munson, city of New York, May 22.

We looked for some new kind of press to be described in the specification of this patent, but found nothing more than a common hand screw press for forcing convex and concave, or other dies together. The patentee, however, says that the dies, or moulds, are a material part of the "*invention;*" of the *apparatus*, he should have said, as we usually apply the term invention, in the way in which it is here used, to those things only which are supposed to be new; a supposition which no one can, in the present instance, entertain, who is in the slightest degree acquainted with the various manufactures of tortoise shell, horn, &c.

It would be difficult to ascertain at what period it was *not* known, in Asia and Europe, that "horn or shell, annealed, or softened, in hot oil, or other liquid, or in any other convenient way, and pressed" into moulds, would receive, and, when cold, would retain, the impression of the mould, yet for doing this, and precisely in this way, the present patent is taken. We had occasion two or three years since to notice the obtaining of a patent for the same purpose, and then spoke of the entire want of novelty in the alleged invention.

43. For an improvement in the *Blast Furnace for Smelting Iron Ore;* Thomas Gregg, Connelsville, Fayette county, Pennsylvania, May 22.

The interior of this furnace is to be circular, and three feet in diameter at the boshes, widening out to three feet six inches at the tunnel head. Within the body of the stack there are to be two air flues, which are to create a draught for two small furnaces on one side of the superstructure, which are called generating furnaces. The flame created by these furnaces is to be brought into contact with the blast at the tuyere, in order to produce ignition at that part in which the force of the issuing blast ordinarily prevents it, and in this way to obviate the collection of cinder, which usually proves so troublesome by adhering around the tuyere.

44. For an improved *Printing Press*, denominated the "Faustus Printing Press;" Seth Adams, Boston, Massachusetts, May 23.

We shall not attempt to describe the manner of arranging the various parts of this press. The patentee claims "the combination of the crank, the cam, and other parts together, so as to move the platen, or frisket, and produce the effects described." The press is to be operated upon by hand, a handle being attached to a fly wheel for that purpose, as in several other presses.

45. For a *Smut Mill;* Stephen Fellows, Sandwich, Stafford county, New Hampshire, May 24.

A wheel of about eighteen inches in diameter is made to revolve vertically in a suitable frame. This wheel has upon its edge, a rim or hoop of sheet iron, which projects over on one side in the manner of the rim of a sieve, and is perforated with holes to allow smut and dust to pass through. Nails, or pins, are driven into this wheel, and project about an inch from it. They are so driven as to form concentric circles about an inch and a half apart. This wheel revolves against a stationary board, a little larger than the wheel, and having nails, or pins, also driven in circles, occupying the spaces between the circles on the wheel. The stationary board is perforated at its centre, so as to form an eye through which the smutty grain is to be fed. Appended to the apparatus is a hopper, and suitable riddles for feeding and separating the grain, and a fan for cleaning it.

The grain, in passing from the centre to the circumference of the revolving wheel, is operated upon by the projecting pins, and also by the rim with its perforations, which cause it to be rough within. The claim is to the wheel and fixed board, with the pins arranged in the manner described.

46. For an improvement in the *Apparatus for Baking or Roasting,* usually called the reflecting tin baker; William Prescott, Boston, Massachusetts, May 24.

This is confessedly the common tin kitchen, but an improvement in it, is claimed, which consists in placing the pan or trough which collects the gravy close to the front, and allowing the lower part of the kitchen to slope forward so as to carry all which falls upon it into the trough. This constitutes the invention, and forms the subject of the claim.

47. For an improvement in *Bedsteads;* Bethel Judd, New London, New London county, Connecticut, May 25.

The bedstead is to be made and put together in the common way, the new invention consisting in an ancient mode of stretching the sacking bottom. To effect this it is to be nailed to loose rails which slide by means of tongues fitting into grooves in the head and foot rails. Screws passing through the side rails of the bedstead, work in nuts let into the slide rails, and serve to tighten the bottom. A short rail, or rather a block, according to the drawing, is to be attached to the head and the foot end of the sacking, a single screw through the head and foot rails working into each.

In the old English fashion, a single sliding rail was used at the head only, with screws passing into it through the head rail, and thus drawing the bottom lengthwise, whilst it was corded at the sides. We have heard English cabinet makers say that were they to return to England, they would introduce the American fashion of cording upon pins, as being preferable to any other. When the sacking is nailed to a rail, as in the plan of the patentee, it forms a secure harbour for bugs, as is well known in our common cots. The screw holes also offer inviting retreats to the same unwelcome bedfellows, and abstract very much from the commendation which any one might otherwise be inclined to give to such a mode of tightening sackings.

48. For a *Sector Tonsillarum*, being an improvement in surgery; William B. Fahnestock, Lancaster, Lancaster county, Pennsylvania, May 25.

The form of this instrument is that of a stem, or shank, of a fifth of an inch in diameter, with a ring on one end of about an inch and a quarter in diameter. The stem is perforated from end to end, to allow a rod, or wire, to pass through it, which rod, or wire, is furnished with an ivory handle at the end opposite to the ring. The ring is split through its plane, and the split, or kerf, extends up the shank a distance equal to the diameter of the ring. A piece of steel plate is made in the form of this ring, with a rod, or wire, projecting from it of sufficient length to pass through to the upper end of the shank, and receive the ivory handle. When these are all in their places, the three thicknesses of which the ring consists, coincide. The inner edge of the lower half of the steel ring is made sharp, and when it is desired to remove a tonsil, or other soft part, the ring is passed over it, and the ivory handle being drawn forward, it is separated by the cutting edge.

The patentee states that the ring may be made to consist of two parts only, one sliding upon the other, but that he prefers the former method.

49. For *Machinery for washing and cleaning Paper Makers' Felts;* Samuel E. Foster, Brattleboro, Windham county, Vermont, May 25.

A hollow cylinder of metal, from four to ten inches in diameter, is to be perforated with holes over its whole surface, its length must of course be such as will adapt it to the machine in which it is to be employed.

The felt is to be made to pass round this cylinder, and is to be borne against it by smaller rollers of wood, and so secured by boxing that but little water shall escape from the perforated roller without passing through the felt. Two other wooden rollers serve to squeeze the superfluous water out of the felt, as it passes between them. Steam may be applied when requisite for the purpose of rendering the felt pliable. The water, or the steam, is to be introduced through hollow gudgeons at each end of the perforated roller.

50. For a *Washing Machine;* Ezra Fisk, Fayette, Kennebeck county, Maine, May 25.

A vibrating rubber, composed of fluted pieces and of rollers, is to operate upon the clothes so nearly in the manner of many other washing machines, that we think a particular description of this, is unnecessary. The patentee considers it as a very superior article, and should the public concur with him in opinion, their praise will be of more value to him than any we are prepared to bestow.

51. For a *Filtering Machine to be used in the art of manufacturing Paper;* Thomas French, Ithaca, Tompkins county, New York, May 26.

This machine is to perform the task of what has been usually called a pulp dresser, some of which instruments we have formerly described. A cylindrical vessel of copper, or of brass, is to be made with slots, or openings from top to bottom, exhibiting the appearance of bars about one-fourth of an inch wide, and one thirty-second part of an inch asunder. It may be made solid, and afterwards cut in this manner, or it may be composed of metallic bars put together. It may also vary in its form, being either square, polygonal, or otherwise. Its diameter may be fifteen, and its height fourteen inches.

A perforated dasher is to be made to play up and down in this vessel, by means of a crank, giving a velocity of from five to six hundred strokes in a minute. The pulp admitted into it is thus forced through between the bars into a vat below, whilst the knobs, &c. are retained, and are removed, when necessary, through a suitable opening. The rim of the dasher stands about half an inch from the sides of the cylinder, and in its vibration approaches the bottom within half an inch, and the top within four or five inches. To supply the cylinder with stuff, a conductor of the requisite size passes through the top, or cover, of it.

The cylinder is enclosed within a close, square box of wood, and one which has been made of the given dimensions, supplies a machine vat which works the pulp beat by two engines. The driving power is said to be equal to about that of a man. If the metallic vessel is made sufficiently strong, so that the bars will not yield to the pressure, the necessity of picking the paper after it is dried, is said to be obviated altogether; whilst, from the agitated state in which the pulp is thrown into the vat, the fibres are more perfectly entangled than is general in machine paper, and it is thereby improved in quality.

52. For a *Washing Machine;* Ebenezer Mayo, Hallowell, Kennebeck county, Maine, May 26.

A drum, or hollow cylinder, which we suppose may be about two feet in diameter, is hung so as to turn vertically in a tub, or trough, the lower edge of the cylinder dipping into the soap suds contained in it. A smaller cylinder, one-fourth or one-fifth the diameter of the former, either plain or fluted, is placed above it, and is caused to revolve by it, the large cylinder is turned by a winch, and the small one is made to bear upon it by springs operating upon its gudgeons. The large cylinder is generally covered with slats placed at a small distance from each other; upon this the articles to be washed are laid, being confined to it by hitching some string, or other small part, between the slats, or otherwise.

It is recommended, in order to prevent the splashing of the suds, to enclose the whole in a box, which must be furnished with a door on one side to inspect and regulate the operation.

53. For a *Horizontal Water Wheel;* Sheldon Stoddard, Jackson, Susquehanna county, Pennsylvania, May 28.

We have here a very imperfect kind of wheel, described with corresponding vagueness. The drawing, however, shows enough of its general construction to prove that it is not new in principle; and as similar wheels have been often tried, we are well assured that it will convey as little of the power of the water to the mill as any wheel well can. The buckets are hung in the manner of doors, or shutters, which are to open and present their broad sides to the current on one side of the wheel, whilst they are to swing and present their edges on the opposite side. Buckets of this description always appear to be very perverse things when set to work, refusing to open at the period set down for them, and thus losing a great part of the time in which it is intended they should labour.

54. For a discovery in *Bleaching Cotton, Linen, and other Cloth;* John B. Greene, Portsmouth, Rockingham county, New Hampshire, May 29.

This discovery consists in first impregnating with alkali the cloth to be bleached, and then subjecting it to the action of chlorine gas, in a suitable apparatus. The alkali, it is said, protects the cloth from injury by the gas; it is afterwards to be cleaned in any of the known ways, and passed through a weak solution of sulphuric acid.

55. For *Rendering Fish Oil Drying;* David C. Knapp, Charles K. Knapp, and Allan H. Howland, Oswego, Oswego county, New York, May 29.

The patentees claim "the preparing and manufacturing the aforesaid oils by chemical agents, in such a manner as shall cause them to dry, and render them fit and proper for all the purposes of painting and glazing, to which linseed oil may be applied.

The mode of effecting this is to boil the oil with litharge, red lead, white lead, white vitriol, or other metallic oxides, or salts. The quantity of the oxides being proportioned to the time in which it is wished that the oil should dry.

Fish oil has been rendered drying, and used for the purpose of painting, many years since. We published a description of a mode of doing this in the first volume of the Franklin Journal, in June, 1826, which we extracted from a volume of the Transactions of the

Society for the Encouragement of Arts, &c. published some years earlier. The recipe there given is as follows—

In refining 252 gallons (one ton) of fish oil, there will be used thirty-two gallons of vinegar, twelve pounds of litharge, twelve pounds of white vitriol, twelve gallons of linseed oil, and two gallons of spirits of turpentine. The drying ingredients are first to be added to the vinegar, and well mixed with it, by agitation, twice a day for a week. This is then to be added to the whale oil, well mixed, and is to be allowed a day to settle, when it is fit to be poured off, and to have the linseed oil and turpentine added to it. Colours prepared with it are said to be bright, and more durable than those used with linseed oil.

It appears, therefore, that the claim to the rendering of fish oil drying by means of chemical agents, is one the novelty of which cannot be sustained.

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56. For *Apparatus for Cooking, and for Heating Rooms;* Jacob Stahl, city of Baltimore, May 29.

There is not much pretension made to invention in this patent, the merit of the apparatus being said to rest upon the particular arrangement of its respective parts. It consists of a stove made of cast and sheet iron, with an oven, in the usual form for cooking, and dampers for regulating the flues. The flues, or pipes, for heated air, are made double, and the space between them is filled with pulverized charcoal, or other bad conductor. When the weather is warm, and the oven is used for cooking, the heat passes off by a short flue; when the heated air is required for warming rooms, a long pipe with elbows, operating as drums, is employed. The claim made is to the particular construction of the apparatus.

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57. For a *Metallic Stereotype Block;* Samuel Sawyer, Boston, Massachusetts, May 29.

(See specification.)

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58. For an improvement in the *Box and Hub of Wheel Carriages, and in the method of Hanging Coach Bodies;* David Watson, Fayette, Kennebeck county, Maine, May 29.

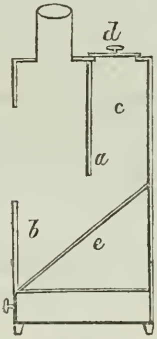
Boxes are to be made of cast iron, of the usual form on the exterior, but with a rebate at each end in the interior, so as to receive a copper ring, cast for the purpose, which is to be five-eighths of an inch deep, and three-fourths thick. These rings are driven in against a shoulder on each end of the cast iron box, and are secured by rivetting; they form the bearing for the axle, the bore of the cast iron between them being such as to allow a space of three-eighths of an inch between it and the axle.

A hole is to be bored through the hub and the iron box at the middle of the axle, for the purpose of supplying oil. A sponge is to be placed in this hole to retain the oil and lubricate the axle, and it is closed by means of a screw, to prevent the entrance of dirt and water.

In hanging carriage bodies, the first improvement described is the putting of steel rollers three inches long, and an inch and a quarter in diameter, at the upper ends of the jacks, over which the thorough braces pass. Under the body of the carriage, and extending from one end of it to the other, over, and in the direction of, the perch, an elastic beam, or strip of wood passes, which is three inches wide, and an inch thick, and this is connected on its under side to levers, by strong spiral springs, which are arranged in a way which could not be clearly explained without the drawings, but which are intended to give the most perfect elasticity to the whole structure, and are, it is averred, capable of being so managed as to cause the passenger to ride with equal ease, whether a stage be loaded lightly or heavily.

The claim is to the copper rimmed boxes, and the mode of applying them; the adaptation of the iron boxes to them; the mode of supplying the oil; and the described manner of hanging the bodies of stages, or other carriages.

59. For an improvement in *Stoves for Burning Anthracite Coal;* Jordan L. Mott, city of New York, May 30.



The improvement here proposed, consists in dividing a stove into two parts by a partition which reaches to the top plate, but does not descend to the bottom of the stove, as is shown at *a* in the section in the margin. The fire is to be lighted at *b* in the usual manner; the part *c* is to be filled with coal, and the cover *d* placed on, which will give a continued supply of fuel by the descent of the coal down the inclined plate *e*, as that in the front is consumed.

The claim is to the dividing of the stove, and the fixing an inclined plate, and grate, for the descent of the fuel.

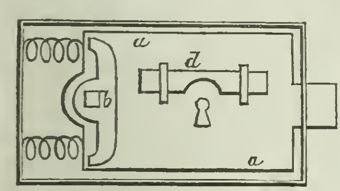
60. For an improvement in the *Silk Reel;* Charles G. Green, Windsor, Windsor county, Vermont, May 30.

The improvement here described is intended to distribute the silk upon the reel with perfect regularity, and thus to prevent the occurrence of the defect which is known by the name of glazing; and consequently to produce silk of a better quality than can be obtained by the common reel. To effect this purpose the reel is made to traverse backward and forward with perfect regularity; this is done by lengthening out the gudgeons of the shaft of the reel, so that they shall each form cylindrical rods of the full length of the reel itself. These turn in boxes upon the frame of the reel, having a crank upon one of them for that purpose.

These rods may be about an inch in diameter, and upon one of them two channels are cut from end to end, one of these forms a right, and the other a left handed screw. A guide piece in one of the boxes, acting alternately in these grooves, causes the reel to traverse backward and forward. This is the part which forms the subject of the patent, it being the only one in which this reel differs essentially from others.

As there are two cylindrical rods, we should suppose that it would be better to have the right hand screw on one of them, and the left hand screw in the other; as in the machine described, these grooves cut each other in their crossing, at every turn. The principle of action would remain the same, although in the case suggested each box must have its guide piece, which could be engaged and disengaged by very simple gearing.

61. For *Spring Catches or Locks for Doors;* Robert J. Byram, Boston, Massachusetts, May 31.



We cannot give the precise structure of this lock without a more lengthened description than we can allot to it. One of its principal features, however, is the making the bolt in such a way that it forms a frame, the rim of which slides against the sides of the box of the lock, as seen at *a a*. The tumbler *b*, standing in the centre of this, draws the bolt back, which is forced forward by the spiral springs *c c*. A small bolt, *d*, shooting against the frame, may serve to lock the door. The patent is taken for these and certain other particular arrangements.

SPECIFICATIONS OF AMERICAN PATENTS.

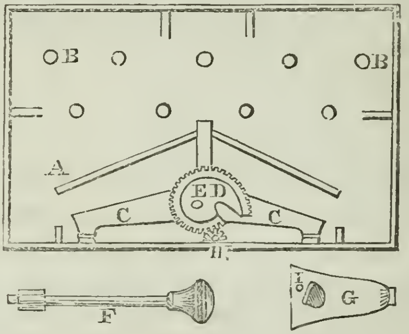
Specification of a patent for a Metallic Stereotype Block. Granted to SAMUEL SAWYER, *Boston, Massachusetts, May* 29, 1832.

To all whom it may concern, be it known, that I, Samuel Sawyer, of Boston, in the state of Massachusetts, have invented a new metallic stereotype block, to be used for the purpose of holding stereotype plates in the process of printing, and that the following is a full and exact description of my said invention.

Instead of forming the stereotype block of wood, in the usual way, I make it of metal, hollow on the underside, and generally cast in one piece, either of iron, brass, type metal, or any other suitable metal, or mixture of metals. Instead of being cast, however, they may be made of sheet metal, in the manner of the iron boxes of common door locks. To support the face plate, or that upon which the stereotype plate is placed, I cast, or otherwise affix within the block, studs, or partitions, of metal, sufficient in number for that purpose, and extending down from the inside of the face plate, so as to bear upon the platen when on the press.

Upon one edge of the face of the block, I cast, or otherwise affix, permanent clasps, or catches, of the usual form for holding the plate; and through openings in the face of the block, at the opposite edge, project the moveable clasps, or catches. These moveable catches, which work through slots or mortices in the face plate, are attached to, and make part of, a metallic plate placed within the block, and sliding against the under side of the face plate. In order to force the catches against the edge of the stereotype plate, I employ an eccentric or spiral wheel, having on its periphery cogs, or teeth, which wheel is acted upon by a key passing through an opening in the edge of the face plate, between the two moveable catches. This key is furnished with teeth, which, taking into those on the edge of the eccentric or spiral wheel, enable the operator to force up or retract the catches at pleasure. The principle upon which this eccentric, or spiral wheel, operates, will be more clearly shown by a reference to the drawing thereof deposited in the patent office.

What I claim as my invention, and for which I ask a patent, is the using of a metallic stereotype block, constructed in the manner herein described; and also the manner in which the moveable catches are operated upon by a key, and an eccentric or spiral wheel, as above set forth, whether the same be made in the exact form represented, or in any other operating upon the same principle, and producing the same effect.



A, under side of the block.
B, B, studs.
C, metallic plate carrying the moveable clasps.
D, spiral toothed wheel, turning on the pin E.
F, key for turning the wheel, and moving the catches.
G, plate which covers the wheel.
H, stop which acts against a rim on the spiral wheel, bearing it against the key.
I, hole for the point of the key.

Specification of a patent for a Pulp Dresser for the purpose of separating the knobs, or grosser particles, from the pulp used in the manufacturing of Paper. Granted to COLEMAN SELLERS, *city of Philadelphia, June* 6, 1832.

To all whom it may concern, be it known, that I, Coleman Sellers, of the city of Philadelphia, in the state of Pennsylvania, have invented a new and improved pulp dresser, for the purpose of separating the knobs, or grosser particles, from the pulp, in the manufacturing of paper, and that the following is a full and exact description of my said invention.

I form a pulp wheel, or dresser, which is made to revolve within the machine containing the pulp, by the application of power in the ordinary way. Fig. 1, in the accompanying drawing, is an end view of the wheel, or dresser, the opposite end being in the same form, and the two being connected together by plates of brass, or other material, which form a complete casing thereto. This wheel, or dresser, is represented as carrying six dressing plates, to be presently described, but this number may be varied as may be found convenient. Fig. 2 is a perspective view of the wheel, showing the plates which pass from end to end, one half of which are plain, and the others so perforated as to form the dressing plates, or strainers, for the pulp. The plates which are perforated to form the strainers I generally place so that their planes form radii with the centre, or axis of the wheel as seen at A A in the drawing. The plane, or unperforated plates, may, at their junction with these, at B B, form a right angle with them; but the form of the plates, and the angles at which they stand, may be varied, without changing the principle upon which they operate. Instead of making the plates flat, they may, for example, be bent so as to form a curve from their exterior to their interior points of junction, as shown by the dotted line C C, fig. 1.

The lines drawn upon the plates A A, fig. 2, represent slots, openings, or perforations, cut through those plates, and forming them into strainers, which allow the finer portions of the pulp to pass through, and arrest the knobs, or coarser particles. These perforations may differ in width, according to the kind of paper to which the dresser is to be applied, but I sometimes make them so that they can be graduated, and the same wheel, or dresser, answer for every kind required. This I accomplish by making the plates double, and perforating them so that when laid upon each other the openings through the two plates shall exactly coincide. By sliding one plate upon the other, by means of a regulating screw, or otherwise, they may then be readily graduated.

D, fig. 2, shows the shaft by which the wheel, or dresser, may be made to revolve. One of the heads of the dresser is open, as at E E, and through this opening the pulp which has been cleaned from the knobs and coarser particles escapes; this end revolves in a hoop, or collar, fixed in an opening in the side of the vat, or machine, in which the dressing is effected.

The most advantageous way of using this wheel, or dresser, is to fix it at such height in the machine as that when one of the plane or unperforated plates F F F F, is upwards, and horizontal, it shall coincide, or nearly so, with the line of the surface of the water; the machine, however, will work if entirely immersed, but not so advantageously.

The perforated faces of the wheel, or dresser, in its revolution, meet the floating pulp, and as they strike against it, the finer parts pass through to the inside, whilst the coarser are arrested; and at the same time, these coarser particles are prevented from accumulating on the surfaces of the strainers by the agitation produced by their striking against, or upon, the fluid.

What I claim as my invention and for which I ask a patent, is the use of a revolving wheel, or pulp dresser, which carries the dressing plates, or strainers, causing them to strike against the fluid containing the pulp, and allowing the dressed portion to pass through to the inside of the wheel, or dresser, acting upon the principle, or in the manner hereinbefore described, whether the same be made in the exact form represented, or in any other producing the same effect.

COLEMAN SELLERS.

Fig. 1.

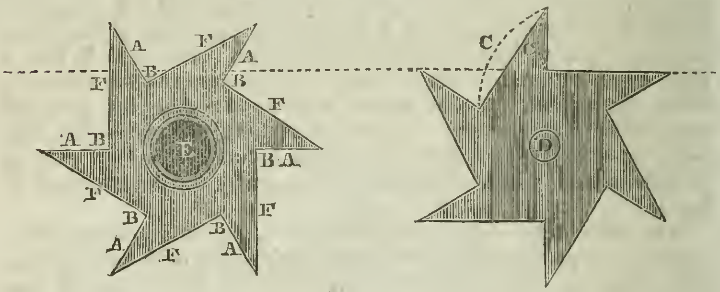
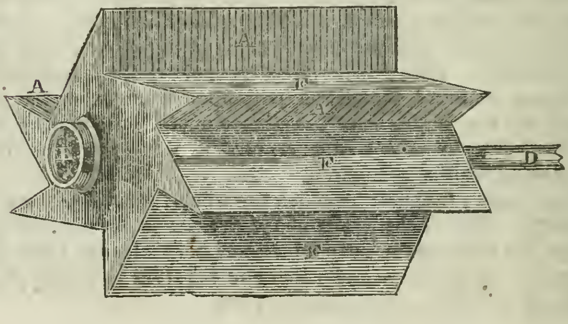


Fig. 2.

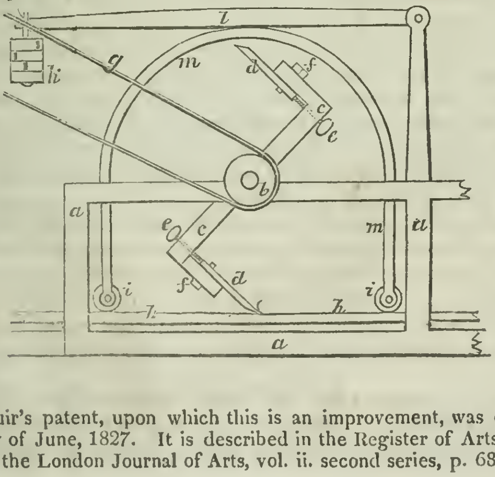


ENGLISH PATENTS.

Patent to M. Muir, *Engineer, for improvements in machinery for preparing Boards for Flooring, and other purposes. Granted December* 22, 1831.

In the third volume of the present series of the "Register,"[*] page 65, we have described a machine, by this patentee, for performing at once the several operations of sawing, planing, grooving, and tonguing flooring boards, and his present patent is for an addition to the same, by which the boards are reduced to a uniform thickness, and therefore completed for laying on the joists. For this purpose the boards are laid upon their faces, or planed sides, and made to pass under a set of revolving adze cutters, by which they are reduced to uniform thickness. The annexed is a sketch of the revolving adzes, where *a a a* show a cast iron frame, with a pulley, or trigger, for giving motion to the cutters *b b*, which are connected with a horizontal axis by means of the rectangular arms *c c; e e* are adjusting screws, to regulate the depth of cut; and *f f* are binding screws, for securing the cutters when adjusted. *g g* show a band by which the motion of the steam engine, or other first mover, is transmitted to the revolving cutters. *h h* show the board to be acted upon, and *i i* are two rollers resting upon the board, and by means of the weight *k*, the lever *l*, and the bent frame *m m*, prevent the board from rising while under the operation of the cutters.

The boards are brought forward to the cutters by means of a chain passing over a drum situated where the frame is shown imperfect. From different links of the chain descend hooks, which hold the end of the board and force it forward as the drum revolves, and when the last end of the board is brought under the drum it is to be pushed forwards by the introduction of another board, and a hook from the



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[*] Mr. Muir's patent, upon which this is an improvement, was obtained on the 1st day of June, 1827. It is described in the Register of Arts, as above, and also in the London Journal of Arts, vol. ii. second series, p. 68.

chain applied to the farther end of that, and so on in succession, during the operation of the machine.

The favourable opinion which we formerly gave of Mr. Muir's planing machine has been completely borne out by the success of the machine, and we have every reason for believing that the patent before us will prove an important addition to his former invention.

[*Reg. of Arts.*

Patent to T. J. Potts, R. Oliver, *and* W. W. Potts, *for an improved method, or process, of obtaining impressions for engravings in various colours, and applying the same to Earthenware. Granted September* 17, 1831.

The employment of a rolling press, to print the intended impression on a continuous web of paper, appears to be the principal object of these patentees. The paper on which the impressions are to be made, is first subjected to the process of sizing. For this purpose, an apparatus, consisting of a sizing trough, in which turns a feeding or supplying roller, over which is placed a sizing roller, both being covered with flannel or printing blanket. These rollers being turned till the flannel becomes saturated with size, a third roller is placed over them, and round this is coiled the web of paper, as it is sized by the pressure of the upper against the middle roller.

The upper roller, with the coil of paper upon it, is then removed to the printing machine. This consists, first, of a colour trough, with a roller to transfer the colour to a metallic cylinder, on which is engraved the design to be transferred to the earthenware, porcelain, glass, &c. To the surface of the engraved cylinder is applied a doctor, or scraper, consisting of a straight steel blade, extending all the length of the cylinder, straightened by pieces of metal, being screwed to each side of it nearly up to the edge, which is pressed against the cylinder by means of a lever and weight, to remove the superfluous colour. The engraved cylinder is made hollow, that its temperature may be considerably increased during the operation of printing, by passing steam through the axis on which it turns, while the colour in the trough is preserved in a fluid state, also by steam, for which purpose it is furnished with an exterior casing and communications from it to a steam boiler.

The paper to be printed is then to be passed through between the engraved cylinder and a pressure roller, by which process are transferred to it a series of impressions, as they have been engraved upon the cylinder. The paper is then to be cut into such pieces as may be required to be applied, to communicate the impressions to the earthenware, which part of the process is to be effected in the usual manner.

When it is necessary (as it is stated to be sometimes) to engrave the intended design on a flat plate, heat is to be communicated by placing the plate over a metallic steam box, instead of over a charcoal fire in the usual way, and making it to traverse forwards and backwards by means of a crank and connecting rod, care being taken, by stuffing boxes, to preserve the communication between the steam boiler and heating box. [*Ib.*

Patent granted to JOHN COWDEROY, *for manufacturing Bread and Biscuits. Dated October* 14, 1831.

This invention is to make bread on a large scale, or to prepare in a shorter time a greater quantity of loaves than manual labour can produce. There is a wooden vessel, tub, or trough, in which is first prepared the liquid matters which form so large a portion of our bread loaves. What these are, Mr. Accum has told us we ought not particularly to inquire into, if we would eat heartily. But setting aside all thoughts of dried bones pounded, alum, yest, potatoes, salt, water, &c. we will suppose the liquor prepared in this wooden vat, or trough. It has a large wooden cock near the bottom, which being open, its contents are issued into an inclined pipe, or channel, or conductor to the kneeding trough. Over this channel is a flour box duly prepared, attached to which is a drum, or cylinder, begirt with rows of brushes, or bristles, to temse or cleanse the flour, forcing it in equal quantities through a wire sieve, so as to make it mix equally, gradually, and completely with the liquor, in order to make a sponge in the kneading trough; it is then allowed to rise, and when the ingredients are added which are necessary to complete its doughy character, it is removed on a long rail-way to a part of the bread manufactory, in which is situated a large frame with a variety of moulds of different sizes and shapes. When the dough is thus made into loaves, or moulded into the prescribed form, it sets off on another rail-way journey, and is conducted safely into the oven in the way most conducive to its easy and speedy baking. When that time comes, the other end of the oven is opened, and an immense feather-edged peel, which moves on wheels, is introduced, and the huge baking is removed in large quantities, and at few batches, from the oven. The process is equally applicable to the production of biscuits, and the whole invention would have been attributed in ancient days to the direct influence and inspiration of the much worshipped deity *Jupiter Pistor*. What a grand accompaniment to the commissariat department of an army, or to the *provant* stores of a besieged garrison! [*Rep. Pat. Inv.*

Patent to J. MABURY, *and* J. MABURY, JR., *for improvements in polishing and manufacturing Ladles, Spoons, and other articles of tinned iron. Granted January* 24*th*, 1832.

The application of a pair of planishing rollers, highly polished, and mounted in a manner similar to that usually adopted for flatting rollers, constitutes the principal part of the improvements contemplated by these patentees. The tin plates are polished by being passed through between the rollers previously to their being formed into ladles, spoons, or other articles of culinary use. In stamping the polished plates into the forms for which they are intended, dies of the usual form, but of much finer finish, so as not to injure the polish of the plates, are to be employed. The articles are then to be finished in the manner usually adopted in completing the manufacture of spoons, ladles, and other culinary utensils.

[*Reg. of Arts.*

FRENCH PATENTS.

Patent granted to Monsieur Le Petit Lamasure, *Jr., Founder, at Rouen, and proprietor of the Forges in the Department of Lot-et-Garonne; for a double case furnace Tewel, supplied with water, and a moveable tube within, to regulate the current of air, for the purpose of economising the combustible and the workmanship; also to obtain a greater proportion of iron.*

General observations upon the inconveniences of ordinary Tewels, and of their position.

The most experienced manufacturers of iron have agreed that the inclination, more or less, in the placing of the tewel, is sufficient for obtaining a fourth, and sometimes even a third, less of the ore, than is procured when the same tewel, by its position, forms a strict angle agreeing with the vertical line that passes by the axis of the furnace.

But supposing that it be easy and convenient to place this tewel, so that the current of air be introduced into the furnace with every requisite advantage, we must admit that it will suffer no derangement or descension during the whole course of the operation, which we cannot allow; for upon this point, and up to the present moment, an imperfection has existed which involves the inevitable causes of the loss occasioned by these said tewels. In fact, after having bestowed much time and pains in the construction of a furnace, wherein scrupulous attention has been observed in properly disposing a tewel of the ordinary form and manufacture, it is no unusual occurrence to find it insensibly altering, and the mouth of the air-pipe changed in figure, and augmented—and this at every instant: a serious inconvenience, because the same quantity of air issuing by two orifices of different dimensions, and propelled by the same force (their relative speed being an inverse ratio to the orifices,) it follows that if the primitive orifice give vent to proper swiftness, and in a convenient direction, it is certain that the one which manifests deterioration will not fulfil the same functions: thence follows the necessity of replacing the worn tewel, in order to make it perform the same duties, which is an operation at once laborious, expensive, and attended with difficulties, on account of the immense heat with which the furnace is impregnated not allowing of a near approach to it; besides which, there results a waste of time; a mass of combustible burned almost without effect; a decided loss of material in the produce, where a given quantity of iron was expected: and, finally, that iron of a bad quality is produced whenever the tewel has been burned.

Means of obviating the inconveniences which arise from the employment of the ordinary tewels.

The double tewel here represented was constructed to remedy the evils just described. This machine is not liable to deterioration upon being exposed to the violence of the fire, because it serves as a reservoir of water that is continually renewed; or, in other terms, because a small course of water passing between the double case, maintains it constantly in a state of freshness, and prevents it from being burned.

It will be seen that in constructing the furnace, after having properly arranged the tewel, it may be firmly fixed, because it will never be susceptible of being deranged from its place; for by means of a conical tube, similar to that of fig. 4, the dimensions of the orifice for the current of wind to be introduced into the furnace may be altered in a moment, according as the operation may require, whether to vary the speed, or the bulk; and this, too, without the direction of it in any case being changed.

By means of this new tewel with its reservoir of water and interior tube, the necessity of the workman is superseded, who is commonly employed the whole year round to repair and readjust the original machine, and who is usually hired at the rate of seven or eight francs a day.

The double case tewel is applicable to every description of tewel, no matter of what form or species.

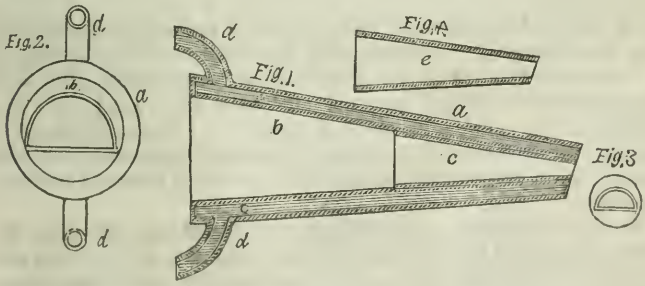

Fig. 1, longitudinal section of the tewel.
Fig. 2, end view in the quarter of the large opening.

Fig. 3, view of the extremity opposite to that of fig. 2.

A, exterior conical case, in brass.

B, interior case, of the same metal and form.

C, annular space reserved between the two cases *a b*, and containing water.

D D, pipes serving to introduce water into the space *c*, and to carry it off.

E, figs. 1 and 4, a small, simple tube, of a conical form, to be inserted at pleasure in the double tube, or tewel, *a b*, in order to graduate the quantity of air that is required to be introduced into the furnace, without any other derangement than that which is necessary to change this small tube for another, the orifice of which is conformable with the effect desired and expected.

[Rep of Pat. Inv. from Brevets d'Inventions.

Patent granted to Sophie Victoire Laine, *for a process for making Gelatine from Bones without muriatic acid, yielding a residuum which may be used as excellent nourishment.*

The beef and mutton bones used in this process are first cleared from the flesh, washed, and completely broken up. When so prepared the bones are placed upon the fire or exposed to steam, with a sufficient quantity of cold water, in an autoclave, or one of Papin's condensing coppers or *marmites;* the upper part being secured by an iron bar, with one or several screws.

The fire, or steam, is urged to a considerable degree for several hours, until the time that the water in the copper, or marmite, has possessed, by ebullition, the whole of the gelatine contained in the bones: after the fire, or steam, has ceased to act, and when the phosphate of lime, entirely deprived of gelatine, is precipitated to the bottom of the vessel, the liquor is drawn off by the means of several cocks adapted to the copper; it is clarified, and, if necessary, afterwards filtered.

The water thus saturated with gelatine is exposed to fire or steam in an open copper; the concentration is carried on till it has attained the consistency of sirop by ebullition, or evaporation, care being taken to agitate it that it may not adhere to the vessel: it is then poured into tin moulds, in which it cools, to be afterwards placed according to the state of the atmosphere, either in a stove, or in the open air, upon canvass or metallic frames, till it becomes perfectly desiccated.

For the evaporation, according to circumstances, Monsieur Derosne's evaporator may be used with success; and in order that even the shadow of an accident may be avoided, the condensing copper described above is supplied with an escape, in the upper part, for giving vent to the redundant steam or air, and which mechanism is controlled in the following manner.

Several circular iron plates are provided, a few inches in diameter, and more or less thick, each of which has a hole in the centre; if the steam escape too forcibly during the boiling, one of these plates is put upon the escape of the condensor, so that the orifice of the escape may correspond with the hole in the plate: this simple apparatus, whilst allowing the escape of the air, or steam, contained in the boiler, immediately controls its too violent release by the action of the heat. If one plate be insufficient, two or three are added, one upon the other; more than four are seldom required, and this feeble moderator is sufficient for avoiding bursting or explosion.

The muriatic acid is totally unnecessary in the process here described, which is unexceptionably salubrious, its residuum, moreover, having the property of being highly nutritious, and of imparting no corrosive and deleterious principle, as occurs in the employment of muriatic acid. [*Ibid.*

¶ *Remarks on Mr. White's experiments on the cohesion of cements, with a tabular view of their results, reduced to a common scale. By B. Bevan, Esq.*

To the editors of the Philosophical Magazine and Journal.

Gentlemen,—The papers on cements, communicated by Mr. White, and published in the Philosophical Magazine and Annals, N. S. vol. xi. pp. 264 and 333, are of considerable importance on account of the numerous facts they contain. They enable the architect and builder to know where, and in what manner, to apply the different kinds of cement, and the degree of stress which may safely be laid upon them.

A careful perusal of the numeral results will point out several common errors, in respect to the cohesive properties of Roman cement and pozzolano, under different modifications, and under various degrees of exposure to moisture.

And as you probably may be of opinion that an abstract of the results given in those papers, reduced to one common scale in a tabular form, may be acceptable to some of your readers, and save much time to individuals, I take the liberty of sending one.

		lbs.	Cohesive strength per inch. Mean.
Cement in bars, age 6 days,	1 dry	474	356
	2 variable	360	
	3 wet	234	
" age 47 days,	1 dry	516	
	2 var.	564	
	3 wet	270	
" age 94 days,	1 dry	210	380
	2 var.	618	
	3 wet	312	

“ age 187 days,	1 dry	534	519
	2 var.	708	
	3 wet	336	
Mean of the dry			433
variable			562
wet			288
	With salt water,		924
	With 51 per cent. of water,		330
	With 64 do.		215
	3 parts cement, 2 parts sand,		456
	1 part cement, 1 part brickdust,		312
Bricks	3 parts cement, 2 parts sand, 6 months,		375
	3 —— —— 2?		362
	All cement	9 months,	360
	Paving bricks, best sort,		253
	—— ——, seconds,		194
	Common building brick, London,*		43
	Common bricks, Soho,		412
Brick cylinders, laid in cement,			27
—————— in cement and sand,			68
————————————,			48
————————————,			53
Brick piers, laid in cement,	2 parts rough lime, 1 part, sand, 1½ parts,	1 month	4⅓
	pozzolano, 3 parts, docking lime,1 part,	6 weeks,	7
	pure cement,		21
	pozzolano, 1; stone lime, 1,		8¼
	Atkinson's cement, 1; sand, 1,		25¼
	ditto,		49¼
	cement, 4; lime, 1,		17

The apparent deficiency of strength in these experiments, probably arose from the position of the resultant and strain in being on one side, instead of in the middle of the piers.

Force required to crush, per square inch.

		lbs.
P. 337.	A 14 inch brick pier, laid in cement	470
	Pozzolano, 3 parts; ground lime 1,	296
	Atkinson's cement 1; sand 1,	410
	Pozzolano, 4; lime 1,	638
	Ditto 3; Dorking lime 1,	600
	Stone-lime 1; sand 3,	500
	Portland stone pier,	2300

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* Stowbridge fire bricks have a strength of 790 lbs. per square inch. The bricks I used at Greenwich well were made at Fenny Stratford, and would support 715 lbs. per square inch; equal to the strength of Yorkshire stone.

A small error may be corrected, Phil. Mag. and Annals, vol. xi. p. 339, line 20, *for* 173½ tons, *read* 149 tons.

Yours, truly,
B. Bevan.

P. S. From the disproportions between the cohesive strength of pure cement and cement used in brick work, it is desirable that further experiments should be made on this subject.

¶ *Safety Tube for the combustion of the mixed gases Oxygen and Hydrogen, invented by M. Hummings.*

A cylinder, about six inches long, and three-quarters of an inch wide, filled with very fine brass wires, in length equal to the tube. A pointed rod of metal, one-eighth of an inch thick, is then forcibly inserted through the centre of the bundle of wires in the tube, by which they are wedged more closely together. The interstices between the wires, which are exceedingly small, are then, in effect, a series of metallic tubes of very minute diameter; the cooling and conducting power of these is far greater than could be produced in a cylinder of equal length even filled with discs of wire gauze, and there is unbroken continuity. All attempts to produce explosion of the gases in this tube, or to compel the flame to return through it, have been effectual. Before the Society of Arts, Mr. Hummings exploded the gases repeatedly in the improved safety chamber now employed in Gurney's blow-pipe, by permitting small portions of water from the well to enter with them, but he could not explode them in his improved tube under precisely the same circumstances, although they were ignited at the aperture (nearly three-quarters of an inch in diameter,) after the jet was removed.

Mr. Hummings kept the gases ignited at this large aperture until the extremity of the tube was in a state of active combustion, which was evident by the dense green flame produced; and although the cooling influence was then greatly diminished, no explosion occurred.

The simplicity of its construction will render the manufacture of the article easy and economical, and its perfect safety will enable the chemical operator to dispense with a very expensive and delicate article of apparatus, in the use of which there is always danger and uncertainty.

[*Phil. Mag. and Jour of Science, No.* 1, 3*d series.*

Trials of Chronometers at Greenwich, in 1831.

We can advance no better evidence of the advantage of the government offering rewards for the improvement of science than the results of the last year's trial of chronometers at the Royal Observatory, and contrasting with them the particulars of the trials in former years, showing the gradual improvement and accuracy of performance of the several chronometers that gained the respective prizes. The public are aware that the lords of the admiralty give annual premiums to the three artists whose chronometers perform with the least variation from mean time, within prescribed limits. In December terminated the ninth annual trial of skill of the numerous artists employed in the construction of chronometers. The prizes were awarded to the following makers, whose chronometers at former periods have been repeatedly purchased by the government. The errors at the close of the trial, as computed by the astronomer royal, and determined by what is termed the trial number, were as follows:

	″	
Mr. Cotterell, Oxford street,	2.93	Trial number.
Mr. Frodsham, jr., Change alley,	3.65	
Mr. Webster, Cornhill,	3.73	

But the actual error, on any of their rates during the year, did not amount to one second of time—a degree of accuracy unprecedented in three chronometers in former trials, in which more than five hundred have been submitted for observation: so perfectly were they adjusted, that either would have enabled a mariner to navigate a vessel round the world with less than one mile error in longitude at the close of such voyage. The errors in their rates were

	″
Mr. Cotterell's - -	0.70
Mr. Frodsham's - - -	0.86
Mr. Webster's - -	0.89

leaving a difference in the whole year, between the first and last, of nineteen hundredths of a second. To prove the accuracy and attention of the gentlemen of the Royal Observatory—a question having arisen as to the justness of awarding one of the prizes, the sum of the year's errors was revised, and the result was a difference of .066 decimal, or sixty-six thousandths of a second in the year's calculation; determining the prize to Mr. Webster, as proposed in the first instance.

We subjoin the performance of the chronometers for the last eight years' trials:—

		″
1823.	First prize - -	11.29
	Second do. - -	12.87
1824.	First do. - -	4.44
	Second do. - -	6.84
1825.	First do. - -	5.44
	Second do. - -	6.12
1826.	First do. - -	2.62
	Second do. - -	3.46
1827.	First do. - -	4.68
	Second do. - -	5.65
1828.	First do. - -	4.41
	Second do. - -	4.52
1829.	First do. - -	2.27
	Second do. - -	3.80
	Third do. - -	4.00

1830.	First	do.	3.59
	Second	do.	4.04
	Third	do.	4.34

[*Phil. Mag.*

Substitute for Printing.

A new process has been discovered and brought into use at Brussels, whereby French books and journals may be printed with great facility and perfect accuracy. It consists of an operation by which, in less than half an hour, the whole of the letter press upon a printed sheet may be transferred to a lithographic stone, leaving the paper a complete blank. By means of a liquid, the letters transferred to the stone are brought out in relief within the space of another hour, and then, with the usual application of the ordinary printing ink, 1500 or 2000 copies may be drawn off resembling minutely the original typography. The immense advantages of this discovery, for which M. Mecus Vandermacien has solicited a patent, may be easily conceived. A first application of this discovery has been made by him upon the "Gazette des Tribunaux," which is to appear at Brussels under a new title.

[*Rep. Pat. Inv.*

Curious Clock.

The Journal of Geneva gives the following description of a clock exhibited in that city, and executed by M. Bianchi, of Verona. This machine, which is especially remarkable on account of its extreme simplicity, is composed only of a pendulum, a large wheel, two escapements, and a quadrature; such are the visible parts. We must, however, suppose that a pinion and a wheel make the communication between the great wheel and the quadrature, though we cannot see them. The pendulum at each vibration causes one of the escapements to advance the great wheel one tooth, which, after this movement, has a pause marking the dead second. As there is no metallic moving power to set the machine going, we find, on examining what keeps up the motion, that the pendulum, which is almost out of proportion with the clock, descends into a case, and there, at each vibration, the ball, or bob, that is furnished with a conductor, approaches alternately two poles, to which voltaic piles supply their portion of electricity. So that the pendulum, when once put in motion, retains it by means of the electricity alternately drawn from the two poles. This machine, which is equally simple and ingenious, is worthy of the attention of the artist. Perhaps other interesting results may be obtained by employing the electric fluid as a moving power, however slight the force such an agent may seem capable of communicating. [*Rep. Pat. Inv.*

The Iron of Borneo.

The iron found all along the coast of Borneo is of a very superior quality, which every person must know who has visited Pontiana or Sambas. At Bangermassing, it is, however, much superior; they have a method of working it which precludes all necessity of purchasing European steel. But the best iron of Bangermassing is not equal to that worked by the rudest Diak; all the best kris-blades of the Bugis rajahs and chiefs are manufactured by them; and it is most singular, but an undoubted fact, that the farther a person advances into the country, the better will be found all instruments of iron. Seljie's country is superior in this respect to all those nearer the coast; his golloks, spears, and kris-blades are in great demand.

There are forty-nine forges at work merely in the campong of Marpow, but the mandows and spears which he uses himself, and gives to his favourite warriors, are obtained further north. Those men live in a state of nature, building no habitations of any kind, and eating nothing but fruits, snakes, and monkeys, yet procure this excellent iron, and make blades sought after by every Diak, whose hunting excursions have in view the possession of the poor creatures, spear or mandow as much as his head, strange as it may sound.

Instruments made of it will cut through over wrought and common steel with ease. We have seen penknives shaved to pieces with them by way of experiment; and one day a wager of a few rupees having been made with Seljie, that he would not cut through an old musket barrel, he without hesitation put the end of it upon a block of wood and chopped it to pieces without in the least turning the edge of the mandow.

In the sultan of Cotti's house there are three muskets, formerly belonging to Major Mullen's detachment, which are each cut more than half through in several places by the mandows of the party which destroyed them. This circumstance being mentioned to Seljie, he laughed, and said that the mandows used on that occasion were not made of his iron, otherwise the barrels would have been cut through at every stroke.—*Abridged from an article in the Singapore Chronicle.*

¶ *Selections from Professor Babbage's Work "on the Economy of Machinery and Manufactures."*

Machine for making Pins.

Some further reflections are suggested by the preceding analysis, but it may be convenient previously to place before the reader a brief description of a machine for making pins, invented by an American. It is highly ingenious in point of contrivance, and, in respect to its economical principles, will furnish a strong and interesting contrast with the manufacture of pins by the human hand. In this machine, a coil of brass wire is placed on an axis; one end of this wire is drawn by a pair of rollers through a small hole in a plate of steel, and is held there by a forceps. As soon as the machine is put in action—

1. The forceps draws the wire on to a distance equal in length to one pin: a cutting edge of steel then descends close to the hole through which the wire entered, and severs a piece equal in length to one pin.

2. The forceps holding the wire moves on until it brings the wire into the centre of the *chuck* of a small lathe, which opens to receive it. Whilst the forceps returns to fetch another piece of wire, the lathe revolves rapidly, and grinds the projecting end of the wire upon a steal mill which advances towards it.

3. After this first, or coarse pointing, the lathe stops, and another forceps takes hold of the half pointed pin, (which is instantly relieved by the opening of the *chuck*,) and conveys it to a similar *chuck* of another lathe, which receives it, and finishes the pointing on a finer steel mill.

4. This mill again stops, and another forceps removes the pointed pin into a pair of strong steel clams, having a small groove in them by which they hold the pin very firmly. A part of this groove, which terminates at that edge of the steel clams which is intended to form the head of the pin, is made conical. A small round steel punch is now driven forcibly against the end of the wire thus clamped, and the head of the pin is partially formed by pressing the wire into the conical cavity.

5. Another pair of forceps now removes the pin to another pair of clams, and the head of the pin is completed by a blow from a second punch, the end of which is slightly concave. Each pair of forceps returns as soon as it has delivered its burthen; and thus there are always five pieces of wire at the same moment in different stages of advance towards a finished pin. The pins so formed are received into a tray, and whitened, and papered in the usual manner.

About sixty pins can thus be made by this machine in one minute; but each process occupies exactly the same time in performing.

Economy in manufacturing illustrated.

Among the causes which tend to the cheap production of any article, and which require additional capital, may be mentioned, the care which is taken to allow no part of the raw produce, out of which it is formed, to be absolutely wasted. An attention to this circumstance sometimes causes the union of two trades in one factory, which otherwise would naturally have been separated. An enumeration of the arts to which the horns of cattle are applicable, furnishes a striking instance of this kind of economy. The tanner who has purchased the hide separates the horns, and sells them to the maker of combs and lanterns. The horn consists of two parts, an outward horny case, and an inward conical shaped substance, somewhat intermediate between indurated hair and bone. The first process consists in separating these two parts, by means of a blow against a block of wood. The horny exterior is then cut into three portions by means of a frame saw.

1. The lowest of these, next to the root of the hair, after undergoing several processes, by which it is rendered flat, is made into combs.

2. The middle of the horn, after being flattened by heat, and its transparency improved by oil, is split into thin layers, and forms a substitute for glass in lanterns of the commonest kind.

3. The tip of the horn is used by the makers of knife handles, and of the tops of whips, and for other similar purposes.

4. The interior, or core, of the horn, is boiled down in water. A large quantity of fat rises to the surface; this is put aside, and sold to the makers of yellow soap.

5. The liquid itself is used as a kind of glue, and is purchased by the cloth dressers for stiffening.

6. The bony substance, which remains behind, is then sent to the mill, and, being ground down, is sold to the farmers for manure.

Besides these various purposes to which the different parts of the horn are applied, the clippings which arise in comb making are sold to the farmer for manure, at about one shilling a bushel. In the first year after they are spread over the soil, they have comparatively little effect, but during the next four or five their efficiency is considerable. The shavings which form the refuse of the lantern maker, are of a much thinner texture: a few of them are cut into various figures and painted, and used as toys; for being hygrometric, they crawl up when placed in the palm of a warm hand, But the greater part of these shavings are also sold for manure, which, from their extremely thin and divided form, produce its full effect upon the first crop.

Manufacture of Eyes for Dolls.

The person examined on this occasion was Mr. Ostler, a manufacturer of glass beads, and other toys of the same substance, from Birmingham. Several of the articles made by him were placed upon the table, for the inspection of the committee of the House of Commons, which held its meetings in one of the committee rooms.

"Question. Is there any thing else you have to state upon this subject?

"Answer. Gentlemen may consider the articles upon the table as extremely insignificant; but perhaps I may surprise them a little by mentioning the following fact. Eighteen years ago, on my first journey to London, a respectable looking man in the city, asked me if I could supply him with doll's eyes; and I was foolish enough to feel half offended; I thought it derogatory to my new dignity as a manufacturer, to make doll's eyes. He took me into a room quite as wide, and perhaps twice the length of this, and we had just room to walk between stacks, from the floor to the ceiling, of parts of dolls. He said, 'these are only the legs and arms; the trunks are below.' But I saw enough to convince me that he wanted a great many eyes; and as the article appeared quite in my line of business, I said I would take an order by way of experiment; and he showed me several specimens. I copied the order. He ordered various quantities, and of various sizes and qualities. On returning to the Tavistock hotel, I found that the order amounted to £500. I went into the country, and endeavoured to make them. I had some of the most ingenious glass toy-makers in the kingdom in my service; but when I showed the eyes to them, they shook their heads, and said they had often seen the article before, but could not make them. I engaged them by presents to use their best exertions; but after trying and wasting a great deal of time for three or four weeks, I was obliged to relinquish the attempt. Soon afterwards I engaged in another branch of business, (chandelier furniture,) and took no more notice of it. About eighteen months ago, I resumed the trinket trade, and then determined to think of the dolls' eyes, and about eight months since, I accidentally met with a poor fellow who had impoverished himself by drinking, and who was dying in a consumption in a state of great want. I showed him ten sovereigns, and he said he would instruct me in the process. He was in such a state that he could not bear the effluvia of his own lamp; but though I was very conversant with the manual part of the business, and it related to things I was daily in the habit of seeing, I felt I could do nothing by his description, (I mention this to show how difficult it is to convey, by description, the mode of working.) He took me into his garret, where the poor fellow had economized to such a degree that he had actually used the entrails and fat of poultry from Leadenhall market to save oil, (the price of the article having been latterly so much reduced by competition at home.) In an instant, before I had seen him make three, I felt competent to make a gross; and the difference between his mode and that of my own workmen was so trifling, that I felt the utmost astonishment.

"Quest. You can now make dolls' eyes?

"Ans. I can. As it was eighteen years ago that I received the order I have mentioned, and feeling doubtful of my own recollection, though very strong, and suspecting that it could [not] have been to the amount stated, I last night took the present reduced price of that article, (now less than half what it was then,) and calculating that every child in this country not using a doll till two years old, and throwing it aside at seven, and having a new one annually, I satisfied myself that the eyes alone would produce the circulation of a great many thousand pounds. I mention this merely to show the importance of trifles, and to assign one reason, amongst many, for my conviction, that nothing but personal communication can enable our manufactures to be transplanted."

Tanning.

The process of tanning will furnish us with a striking illustration of the power of machinery in accelerating certain processes in which natural operations have a principal effect. The object of this art is to combine a certain principle, called *tannin*, with every particle of the skin to be tanned. This, in the ordinary process, is accomplished by allowing the skins to soak in pits containing a solution of tanning matter; they remain in the pits six, twelve, or eighteen months; and in some instances (if the hides are very thick) they are exposed to the operation for two years, or even during a longer period. This length of time is apparently required in order to allow the tanning matter to penetrate into the interior of a thick hide. The improved process consists in placing the hides, with the solution of tan, in close vessels, and then exhausting the air. The consequences of this is to withdraw any air which might be contained in the pores of the hides, and to employ the pressure of the atmosphere to aid capillary attraction in forcing the tan into the interior of the skins. The effect of the additional force thus brought into action can be equal only to one atmosphere; but a further improvement has been made: the vessel containing the hides is, after exhaustion, filled up with a solution of tan; a small additional quantity is then injected with a forcing pump. By these means any degree of pressure may be given which the containing vessel is capable of supporting; and it has been found, that by employing such a method, the thickest hides may be tanned in six weeks or two months.

The same process of injection might be applied to impregnate timber with tar, or any other substance adapted to preserve it from decay; and if it were not too expensive, the deal floors of houses might be thus impregnated with alumine or other substances, which would render them much less liable to be accidentally set on fire. Some idea of the quantity of matter which can be injected into wood by great pressure may be formed from considering the fact stated by Mr. Scoresby respecting an accident which occurred to a boat of one of our whaling ships. The line of the harpoon being fastened to it, the whale in this instance dived directly down, and carried the boat along with him. On returning to the surface, the animal was killed, but the boat, instead of rising, was found suspended beneath the whale by the rope of the harpoon; and on drawing it up, every part of the wood was found to be so completely saturated with water as to sink to the bottom.

Durability of Watches.

The durability of common watches, when well made, is very considerable. One was produced, in "*going order*," before a committee of the House of Commons, to inquire into the watch trade, which was made in the year 1660; and there are many of ancient date in the possession of the Clock-makers' Company, which are actually kept going. The number of watches manufactured for home consumption was, in the year 1798, about 50,000 annually. If this supply was for Great Britain only, it was consumed by about ten and a half millions of persons.

Process in the art of Needle Making.

To arrange 20,000 needles thrown promiscuously into a box, mixed and entangled with each other in every possible direction, in such a form that they shall be all parallel to each other, would at first sight appear a most tedious occupation; in fact, if each needle were to be separated individually, many hours would be consumed in the process. Yet this is an operation which must be performed many times in the manufacture of needles, and it is accomplished in a few minutes by a very simple *tool;* nothing more being requisite than a small flat tray of sheet iron, slightly concave at the bottom. The needles are placed in it, and shaken in a peculiar manner, by throwing them up a very little, and giving at the same time a slight longitudinal motion to the tray. The shape of the needles assists their arrangement, for if two needles cross each other, (unless, which is exceedingly improbable, they happened to be precisely balanced,) they will, when they fall to the bottom of the tray, tend to place themselves side by side, and the hollow form of the tray assists this disposition. As they have no projection in any part to impede this tendency, or to entangle each other, they are, by continual shaking, arranged lengthwise in three or four minutes. The direction of the shake is now changed, the needles are but little thrown up, but the tray is shaken endwise, the result of which is, that in a minute or two the needles which were previously arranged endwise, become heaped up in a wall, with their ends against the extremity of the tray. They are now removed by hundreds at a time, by raising them with a broad iron spatula, on which they are retained by the fore finger of the left hand. During the progress of the needles towards their finished state, this parallel arrangement must be repeated many times, and unless a cheap and expeditious method had been devised, the expense of manufacturing needles would have been considerably enhanced.

Another process in the art of making needles furnishes an example of one of the simplest contrivances which can come under the denomination of a *tool.* After the needles have been arranged in the manner just described, it is necessary to separate them into two parcels, in order that their points may all be in one direction. This is usually done by women and children. The needles are placed sideways in a heap on a table, in front of each operator, just as they are arranged in the process above described. From five to ten are rolled towards the person by the fore finger of the left hand; this separates them a very small space from each other, and each in its turn, is pushed lengthwise to the right or to the left, according as its eye is on the right or left hand. This is the usual process, and in it every needle passes individually under the finger of the operator. A small alteration expedites the process considerably; the child puts on the fore finger of its right hand, a small cloth cap or finger-stall, and rolling out of the heap from six to twelve needles, he keeps them down by the finger of the left hand, whilst he presses the fore finger of the right hand gently against their ends: those which have the points towards the right hand stick into the finger-stall, and the child removing the finger of the left hand, slightly raises the needles sticking into the cloth, and then pushes them towards the left side. Those needles which had their eyes on the right hand do not stick into the finger cover, and are pushed into the heap on the right hand previously to the repetition of this process. By means of this simple contrivance each movement of the finger from one side to the other carries five or six needles to their proper heap; whereas, in the former method, frequently only one was moved, and rarely more than two or three were transported at one movement to their place.

Meteorological Observations for October, 1832.

Moon.	Days.	Therm.		Barometer.		Dew point	Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P.M.	Sun rise.	2 P. M.		Direction.	Force.		
				Inches	Inches.				Inches.	
☽	1	53°	61°	29.70	29.65	57	W.	Moderale.	.40	Cloudy—rain—fly'g. cld's.
	2	45	60	.65	.65	46	W.	do.		Flying clouds.
	3	40	56	.65	.65	44	W.	Blustering.	.40	Foggy—clouds—rain in night.
	4	45	66	.65	.65	47	SW.	do.		Clear day.
	5	48	68	.80	.85	51	W.	Moderate.		Clear day.
	6	46	68	.85	.85	52	W.	do.		Foggy—clear.
	7	50	59	.75	.75	58	SE.	do.		Fog—rain.
	8	51	58	.90	30.00	53	NW. SE.	do.		Cloudy day.
☺	9	56	60	30.10	.15	58	SE	do.		Cl'dy; drizzle; rain in n't.
	10	61	76	.00	29.90	66	S.	do.		Rain—flying clouds.
	11	64	59	29.70	.70	62	SW.	Blustering.		Cloudy; rain; flying cl'ds.
	12	47	61	30.00	30.00	49	W.	do.		Clear day.
	13	52	62	.00	.00	49	W.	Moderate.	.20	Cloudy—rain.
	14	53	58	.00	.10	45	W.	do.		Cloudy—clear.
	15	38	60	.30	.30	33	W.	do.		Light frost—clear.
☾	16	34	57	.30	.30	42	SW.	do.		Clear—white frost—clear.
	17	48	63	.14	.10	53	SW.	do.		Fog—clear.
	18	52	70	.00	.00	61	SW.	do.		Fog—clear.
	19	60	70	.05	.10	61	SE.	do.		Lightly cl'dy. flying cl'ds.
	20	57	72	.00	29.90	62	S.	do.		Cloudy—clear.
	21	62	68	29.90	30.00	53	S.	do.		Clear day.
	22	49	49	30.00	29.90	51	NE.	Blustering.	.40	Rainy day.
⊗	23	46	58	29.70	.70	52	W.	do.		Cloudy day.
	24	42	52	.90	.90	30	N. NW.	do.		Cloudy—flying clouds.
	25	40	54	.90	.90	34	NW.	do.		Cloudy—flying clouds.
	26	32	42	30.25	30.34	21	NW.	do.		Clear day.
	27	34	52	.20	.10	40	W. SW.	Moderate.		Cloudy—clear.
	28	38	42	.10	.20	27	NW. W.	do.		Cloudy—clear.
	29	28	52	.30	.30	31	N.	Blustering.		Clear day.
	30	34	58	.30	.30	38	NW. W.	Moderate.		Hazy—sun red.
	31	36	56	.30	.20	38	W.	Calm.		Clear—hazy.
	Mean	46.67	59.35	29.98	29.96	47.2			1·40	

		Thermometer.	Barometer.
Maximum height during the month,		76. on 10th.	30.34 on 26th.
Minimum	do. . . .	28. on 29th.	29.65 on 1st, 2nd, 3d, 4th.
Mean	do. . . .	53.01 . .	29.98

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